NOVEMBER 1959

Power Engineering

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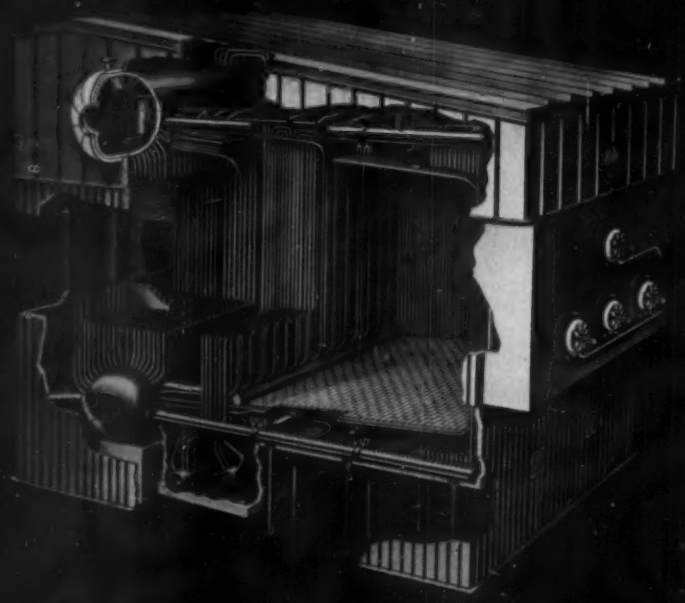

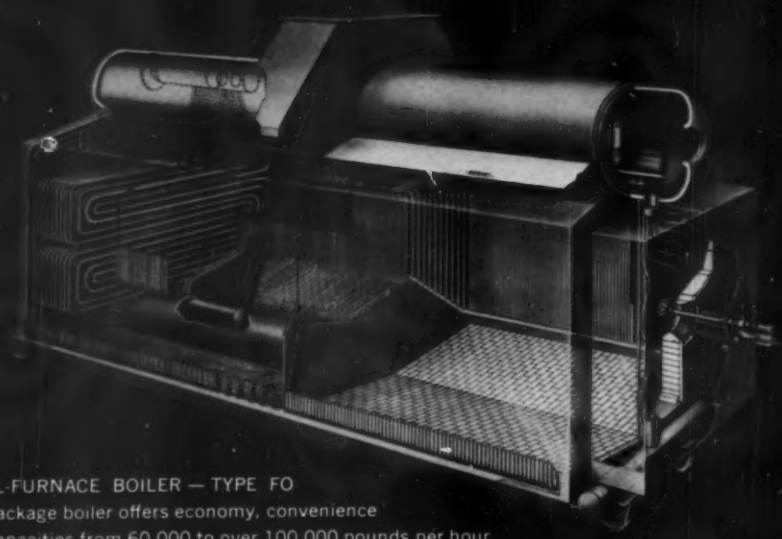

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

CENTRAL VERMONT Public Service Corp has placed an order for a 20,500-kw peaking gas turbine-generator unit with General Electric's Gas Turbine Department. Delivery of the unit is scheduled for mid-1962, and it will be the fourth GE gas turbine to operate on the Central Vermont Public Service system.

The order is the third received this year for this new line of combustion gas turbines to be used to meet peak demands for electric power. Others will be delivered to the Philadelphia Electric Co and the New Orleans Sewerage and Water Board.

The simple-cycle, single-shaft gas turbine for Central Vermont is designed to burn distillate oil and is rated 20,500 kw when the inlet temperature is 80 F. When the outside temperature drops to zero, the gas turbine has a capability of 28,000 kw. It will drive a 27,059-kva air-cooled generator.

SIGNAL from outer space, originating on a U. S. satellite orbiting some 23,000 miles from the earth, officially dedicated the new facility of Lear, Inc, Instrument Division, recently in Grand Rapids, Mich. The signal was picked up through the Astro Observation Station of the United States Army Signal and Research Development Laboratory at Fort Monmouth, N. J., and bounced to the new Lear plant.

RUSSIA is not engaged in a race with the United States or any other country in development of atomic power. So says James F. Davenport, executive vice-president of Southern California Edison Co, after a 10,000-mile trip through the Siberian area of the Soviet Union.

Conventional steam plants enjoy the top construction priority in the electrical field in Russia, Davenport says. Second priority is given hydroelectric power construction — with atomic plants in third place.

First priority goes to steam because this is quicker and less costly to build, and the Siberian area has enormous resources of coal.

Davenport reports that the Bratsk hydroelectric station on the Angara River, on the border of Outer Mongolia, will be the biggest hydro generating station in the world when it is completed, with a capacity of 4,000,000 kw.

GOOD WORK is being done in Illinois in stimulating informed thinking on problems of industrial water management. For the past three years the Water Resources Committee of the Illinois State Chamber of Commerce has put on a lively conference which deals with the various aspects of water as a raw commodity. This year the theme was industrial water supply.

One of the conference's speakers, Dr. Everett P. Partridge, director of the Hall Laboratories, asked these challenging questions: "What will be happening over the next decade to affect the value and the cost of water to industry? Will we no longer need water for power generation? Will we be recovering water from the oceans at a cost sufficiently low to make it attractive? Will we be able to control the weather, distributing precipitation where it is most needed?"

To these intriguing possibilities, Partridge's answer was, "I think not." In his opinion, ten years from now we will still be producing from fossil fuels all of our kilowatts other than perhaps 15 per cent from hydroelectric installations. While some of the fossil fuels will be burned directly in turbines, steam power plants will still provide more than 75 per cent of the greatly-increased flow of electrical energy. What power is actually being produced from nuclear energy will probably still involve the water-steam cycle, Partridge thinks.

Recovery of usable water from the oceans and from inland brines will, he predicts, be practiced in a few situations, but in his judgment the cost will remain too high to encourage any substantial adoption by industry.

Some local successes in rainmaking by the seeding of clouds will continue to be reported, but we shall still have to rely, Partridge feels, on storing water to carry us through the cycles from too much to too little in the runoff from natural precipitation.

UTILITY POWER LINE relocation costs constitute what is today the major problem in connection with the new highway program. They are discussed in a recent book from the University of Oregon.

Traditionally, and often by law, utilities have used highways as their rights-of-way for power lines. Changes involve relocation costs, so that it is often questionable whether this proves an advantage or a disadvantage for the utilities. The new Federal highway program considers the possibility of taxing the utilities for this privilege. Relocation costs, unless borne by the state, might work severe hardships on some of the utility companies.

The Bureau of Business Research of the University of Oregon at Eugene, Oregon, has just published this pioneer economic study in this field, prepared for the Oregon State Highway Commission in coöperation with the U. S. Bureau of Public Roads. It deals with the implications in free use by electric utilities of rural highway rights-of-way for their poles. The title of the study is "Electric Utility Non-user Benefits from Oregon Highways." It is treated as a state problem; but, as a comprehensive treatise, it is research of tremendous importance to the electric utilities. Copies cost $1 each and may be ordered from Bureau of Business Research at the above address.

BEN ELLIOTT, professor of mechanical engineering and head of that department at the University of Wisconsin, is retiring from the university faculty this year. During his many years of teaching and research in mechanical engineering, Elliott's special fields have been internal combustion engines and automobiles, and steam power.

The Wisconsin professor received his technical education at Rose Polytechnic Institute, gaining his bachelor's degree in 1910 and his master's in 1911. The degree of professional mechanical engineer was conferred upon him by the University of Wisconsin in 1913. He was appointed to his position as chairman of the mechanical engineering department in the UW College of Engineering in 1947.

Throughout his professional life, Elliott has been a member of many technical societies and an active participant in their affairs. He was elected a regional vice-president of the ASME in 1952 and was named a fellow in that organization in 1953. In 1956 he was appointed to the Engineers' Joint Council.

ASME annual meeting will be held Nov 30 to Dec 4 at the Chalfonte and Haddon Hall Hotels in Atlantic City, N. J. Over 300 technical papers and discussions will be given. Among featured speakers is Lieut Gen James M. Gavin, formerly director of U. S. Army Research and Development. Ten awards will be given.

DR. JOSEPH L. GILLSON, of Wilmington, Del, chief geologist of E. I. du Pont de Nemours & Co, has been elected president for 1960 of the 35,000-member American Institute of Mining, Metallurgical, and Petroleum Engineers. Dr. Gillson will take office during the annual meeting of the Institute, to be held in New York City next Feb. 14-18. As president-elect, AIME has named Ronald E. McNaughton, of Trail, British Columbia, manager of the Metallurgical Division of the Consolidated Mining & Smelting Co of Canada, Ltd.

Promotions of Theodore I. Montelin to the position of steam engineer, and of Edward L. Lynsky to the position of power engineer have been announced by George Craig, Chief Engineer of Brown Company, paper manufacturers of Berlin, N. H. Montelin has been maintenance engineer in Brown Co's Power and Steam Department since 1953. Lynsky will supervise all electrical generation and power maintenance functions. He has been a member of the Engineering Department at Brown Co since 1951, and is a graduate of Northeastern University.

Samuel Glasstone, consultant to the Los Alamos Scientific Laboratory, Los Alamos, N. M., has been picked to receive ASME's Worcester Reed Warner Medal, given for an outstanding contribution to the permanent literature of engineering. Glasstone is being cited "for his outstanding contribution to permanent engineering literature in his writing on atomic energy as exemplified by his book, Sourcebook on Atomic Energy."

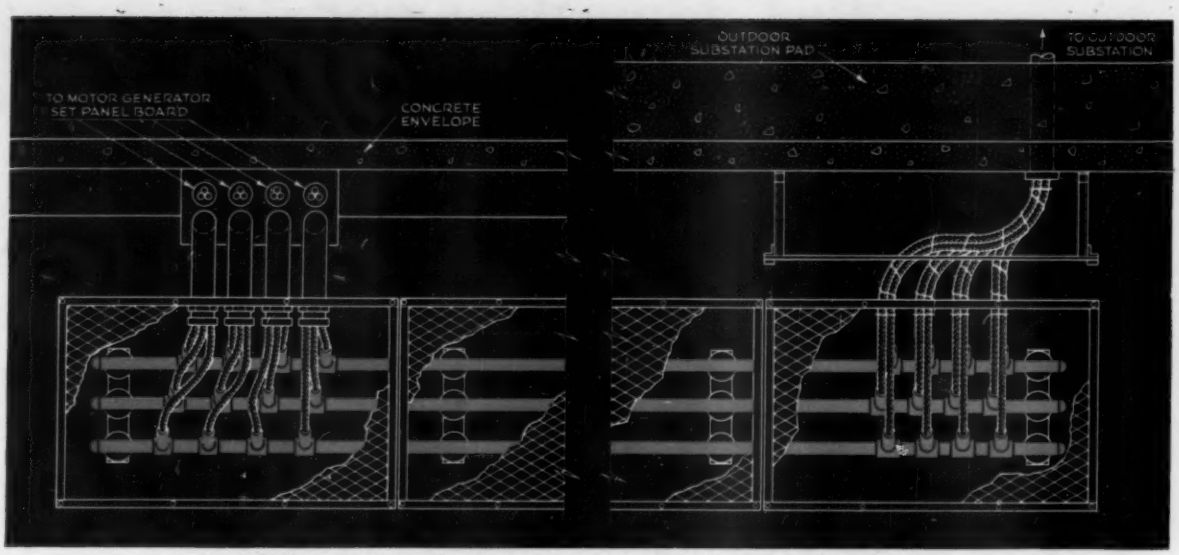
Ernest J. Wallner has been appointed engineer-in-charge of the project section, steam turbine department at Allis-Chalmers, and Raymond N. Sutphin has been named supervisory engineer of the section. Wallner has been associated with Allis-Chalmers' steam turbine department since 1941. He is a graduate of the University of Wisconsin. Sutphin came to the company in 1952. He is a graduate mechanical engineer of Stevens Institute of Technology.

Fred R. Bruce is the new secretary for the Western Society of Engineers. Bruce completed his Business Administration course at the University of Minnesota in 1933. From 1935 through 1958, he was employed in the Chicago headquarters office of the Greyhound Corp as an accountant, statistical analyst, and office manager.

Walter Crafts, associate director, technology, Union Carbide Metals, has been named president of the American Society for Metals.

460-KV transmission line will be built by Pennsylvania Electric Co. It will be about 13 miles long, will be located so that it can be integrated with the company's present network and used under daily operating conditions. Highest voltage presently used in the system is 230 kv. The new extra-high voltage line is being built to combine scientific research with practical operating experience and as part of a continuing program to meet anticipated demands for electricity.

Three manufacturers will supply the special equipment needed: GE, a 115/460-kv transformer for one terminal and switching equipment for both ends; Pennsylvania Transformer Co, a 115/460-kv transformer for the second terminal; Ohio Brass Co will coöperate in designing the insulators and insulator hardware. Various types of wood poles structures will be used experimentally, as will both steel tower and steel pole construction.



Side elevation of secondary bus system, using round tubular copper bus conductors, 2½" S.P.S., in unused plant tunnel. The run is approximately 275 feet long.

Round copper tube bus carries more amperes per pound of copper—cuts installation costs

When a large eastern electrolytic refinery recently shifted to purchased electric power, it capitalized on the electrical and mechanical advantages of round tubular copper bus conductors to effect some economies.

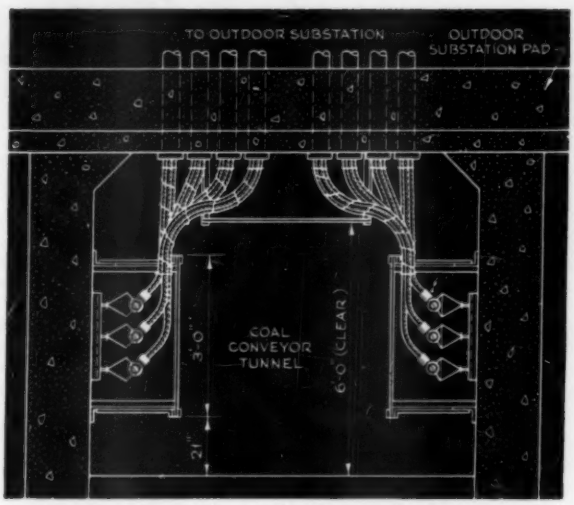
Directly below the 10,000 kv-a outdoor substation was an unused coal conveyor tunnel that ran some 275 feet back to the former powerhouse. In this, the secondary bus system using 2.3-kv high-conductivity bus tube, 2½" S.P.S., was installed as shown in the drawings.

These round conductors, having an extremely low skin-effect ratio (1.01) can carry well over 300 amperes per pound of copper—compared with less than 275 amperes per pound for rectangular bus of the same cross-sectional area.

In addition to this material saving, round conductors in standard pipe sizes made possible installation savings through the use of stock-size supports, connectors, and other hardware.

Substantial savings are often possible through the use of a tubular bus with a low wall-thickness-to-diameter ratio. More complete information on tubular conductors is available in the Sixth Edition of The American Brass Company's Publication C-25. This 62-page booklet has a wealth of general information on the properties of copper conductors—plus convenient data for the most commonly used sizes of all types of rigid bus conductors.

TECHNICAL SERVICES. Anaconda specialists are available to help you in the solution of technical problems involving the use of Anaconda Bus Conductors. For such service, or for a copy of Publication C-25, see your nearby Anaconda representative. Or write: The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass, Ltd., New Toronto, Ontario.



End elevation of tunnel showing how bus conductors are mounted on either wall, covered by a simple expanded metal enclosure.

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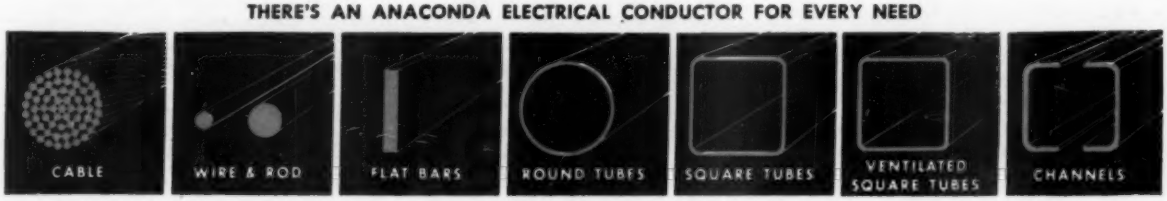

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WHAT THEY TELL US

▶ **THE SITUATION** surrounding arc welding codes and specifications is controversial, to say the least. Are such codes really necessary? Howard B. Cary, director of Hobart Brothers Technical School in Troy, Ohio, sends us this thoughtful opinion on the question:

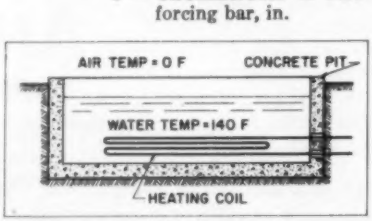
> Those who severely criticize welding codes are usually in the welding industry, but it is questionable if they would remove or eliminate the quality control specification that they employ in purchasing or inspecting materials they utilize in their own products.
>
> American Welding Society has done a notable job of standardizing the welding provisions in the different codes. Much more work of this nature needs to be done.
>
> It is true that those involved with one code or codes covering similar work become extremely familiar with the specific requirement of that code. It is only when a number of codes are considered together that they become confusing. In our new book, "Hobart Basic Arc Welding Manual," one chapter is devoted to a discussion of the various welding codes and their provisions.
>
> A consolidation of requirements of the welding sections of codes in existence in this country, which would cut across the various lines now established, would be very beneficial. A possible objective would be a single welding code comprising sections devoted to various applications or industries, providing for various levels of quality. Testing procedures would be standardized with variations peculiar only to specific applications.
>
> In conjunction with such a code, various levels of service requirements and various levels of acceptability with respect to radiography inspection, magnetic particle inspection, etc, would be established. The level of acceptability and applicable sections of the general code would then be a matter of agreement between purchaser and supplier.
>
> In conjunction with this single general code would also be provisions for welding operator qualification also at various levels of proficiency.

▶ **FLUOR MAINTENANCE,** Inc, a subsidiary of The Fluor Corporation, Ltd, has been awarded a continuous contract by the Pabco Division of Fibreboard Paper Products Corp to supply all maintenance services at Pabco's manufacturing complex at Emeryville, Calif. Charles Day, vice-president of Fluor Maintenance, tells us:

> This is one of very few industrial plant maintenance contracts ever let in which a contractor has been assigned to carry out all phases of maintenance, with the owner providing no maintenance workers of his own. Also, it is the first contract Fluor Maintenance has ever taken outside of the petroleum field.

▶ **IN THIS DEPARTMENT,** on page 6, May, 1959 issue, K. Hodges requests comments regarding snow removal facilities. He is considering use of a concrete pit containing hot water into which snow would be dumped and melted. Hodges questions if temperature difference between heating medium and ambient may cause cracking of the concrete. Reader H. B. Wayne tells us:

> Relations between temperature change and resulting stress for reinforced concrete may be expressed as follows:
>
> $\Delta_c = k_c \times T \qquad \Delta_s = k_s \times T$
>
> $S_s = (\Delta_c - \Delta_s)\, E_s$
>
> $F = S_s \times A_s$
>
> $$S_b = \frac{F}{C}$$
>
> where:
>
> Δ_c & Δ_s = Unit strain of concrete and steel respectively — in. per in.
>
> k_c & k_s = Coefficient of expansion for concrete and steel in. per in. per degrees F
>
> T = Temperature change, degrees F.
>
> S_s = Steel stress, psi.
>
> E_s = Modulus of elasticity for steel, psi.
>
> F = Total force exerted by steel — lb.
>
> A_s = Area of steel, sq in.
>
> S_b = Bond stress, psi.
>
> C = Circumference of reinforcing bar, in.



Here is a sketch showing principal features of this type of installation with assumed temperatures indicated. Coefficient k_c of expansion for steel is usually taken at 0.0000065 in/in F. Assuming a value of 0.0000070 for concrete and substituting the numerical data into the above equations, gives the following stress values:

$\Delta_c = 0.0000070\ (140 - 0) =$ 0.00098 in. per in.

$\Delta_s = 0.0000065\ (140 - 0) =$ 0.00091 in. per in.

$S_s = (0.00098 - 0.00091)\ 30000000 = 2100$ psi.

Assume 1 in. diam rods, A = 0.79 sq in.

$F = 2100 \times 0.79 = 1660$ lb.

$$S_b = \frac{1660}{3.14 \times 1.0} = 531 \text{ psi.}$$

Since the above is based upon assumed data, the actual values will probably differ. For installations located in areas subjected to extreme weather, water-cement ratio should not exceed 6 gal per sack of cement. Also, reinforcement near the concrete surface should be protected with not less than 2 in. of cover for flat surfaces. A minimum of 3 in. is recommended at corners. Sharp corners should be avoided, because abrupt change of section induces stress concentrations.

▶ **WALTERIO WATT,** a mechanical engineer with Cia. Chilena de Electricidad in Santiago, Chile, is a new reader of POWER ENGINEERING, from whom it is good to hear. Watt writes us from Chile:

> I graduated from Purdue University and am in charge of maintenance of eight hydroelectric plants and three steam electric plants. . . . POWER ENGINEERING is going to be very useful to me. I received June's issue and am interested in receiving the whole series of articles on maintaining centrifugal pumps.

▶ **IS THERE ANY KIND** of a device, available for heating systems, that combines a pressure-relief valve and a vacuum breaking device in a single assembly? One of our readers has a heating system in which there is a large water storage tank, and for various reasons he had to install on that tank both a separate pressure-relief valve and a vacuum breaker. That solved his problem, all right, but now he asks about a combined assembly.

We have never heard of such a combination unit, but we referred the question to Frank E. Moran, a Chicago expert on heating and piping, who tells us:

> Like you, we have never heard of a combined pressure-relief valve and a vacuum breaking device. We of course use pressure-relief valves on heating systems and know that vacuum breakers are required, under codes, on domestic water lines; so we believe that if both items are required, separate ones should be used.

Some Straight Talk On Steam Trap Capacity

... or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counter-claims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

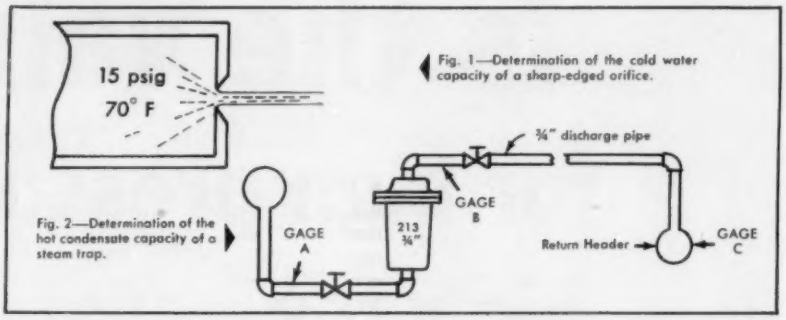


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hook-ups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8102 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

"See our catalog in Sweets Plant Engineering File"

For more data circle 504 on Post Card

WELBOND®

is the valve for high pressures, high temperatures

Yarway Welbond Valves are available in 9 sizes, ¼" to 2½", angle and straightway designs. Pressures to 2500 psi, temperatures to 1050° F.

Welbond is the valve designed by Yarway specifically to provide modern steam power plants with the ultimate in high pressure, high temperature valve service.

These special Welbond features insure improved valve performance:

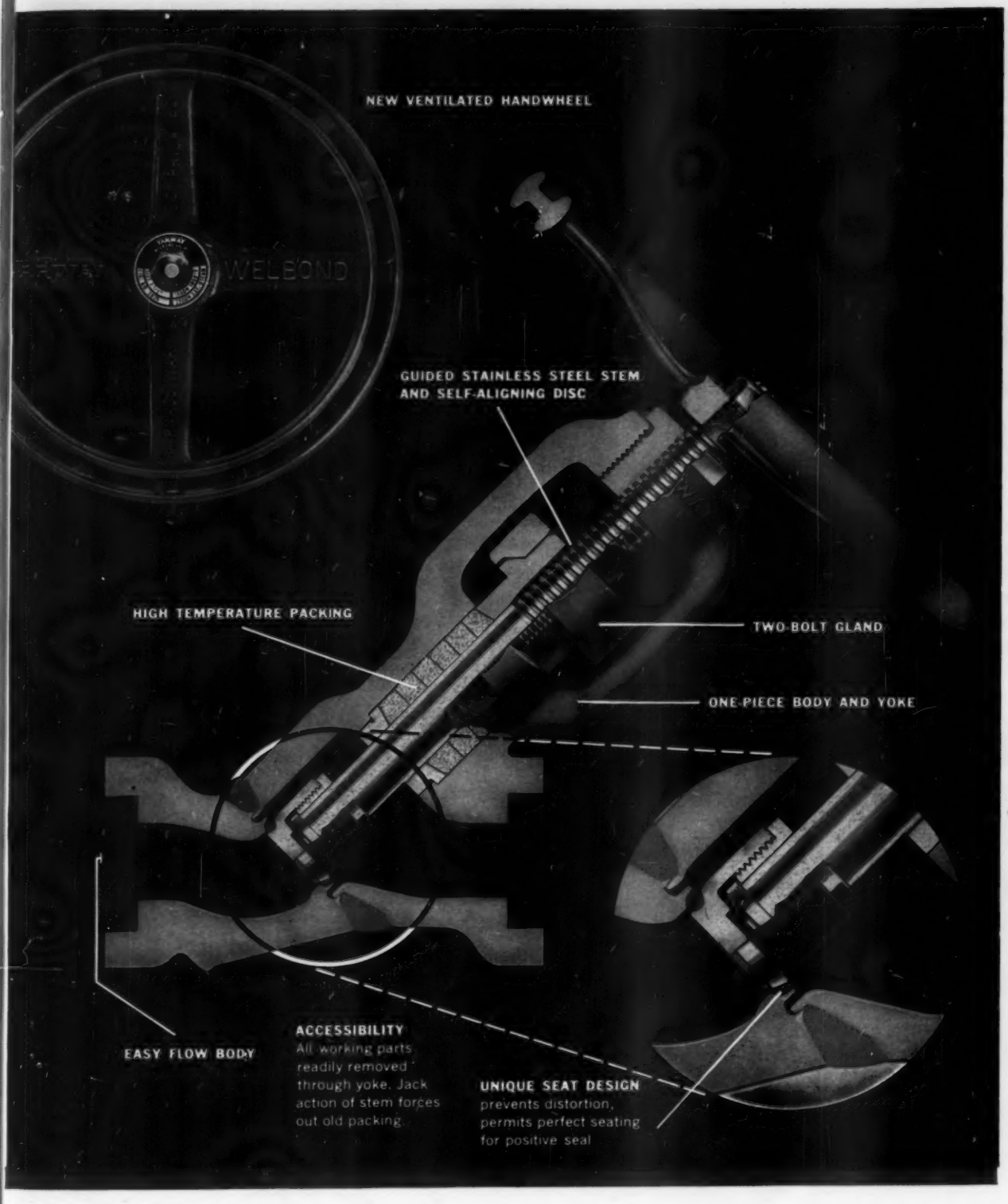
- **Stem** of 321 stainless steel, used with special **packing** to prevent stem corrosion
- Easy and quick **accessibility.** All working parts removable through yoke.
- Non-distorting, thermally-compensated **seat**
- Ventilated, easy grip **handwheel**
- **Streamlined flow** through body

Welbond Valves are winning approval on superheater vents and drains, water wall drains, economizer drains, steam gage shut-off, strainer blow-off and many other steam plant services. Your Yarway man will be glad to discuss applications for your plant.

For full information, write for Yarway Bulletin B-452.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY · WELBOND · *a good*


NEW VENTILATED HANDWHEEL
WELBOND
GUIDED STAINLESS STEEL STEM AND SELF-ALIGNING DISC
HIGH TEMPERATURE PACKING
TWO-BOLT GLAND
ONE-PIECE BODY AND YOKE
EASY FLOW BODY
ACCESSIBILITY
All working parts readily removed through yoke. Jack action of stem forces out old packing.
UNIQUE SEAT DESIGN
prevents distortion, permits perfect seating for positive seal

way to specify high pressure/high temperature valves

OIL'S FIRST CENTURY
~BORN IN FREEDOM
WORKING FOR PROGRESS

IN the beginning there was a dreamer and a dream. The dreamer was Col. Edwin L. Drake - - - his dream was to drill the first oil well in the history of the world so the collection of oil could be simplified. To accomplish this end he needed a small boiler and a steam engine. These first pieces of steam power equipment were supplied to Col. Drake by a then relatively small progressive foundry and machine shop - - - Erie City Iron Works.

ERIE CITY Since 1840

★ OVER A CENTURY IN STEAM GENERATION WORKING FOR PETROLEUM

Now 100 years later the needs and the requirements of the giant oil industry are not quite so simple nor so easily solved. Numerous installations of large packaged and field assembled steam generators are required to produce the millions of pounds of steam used daily by the oil and petrochemical industries.

Erie City has kept constant pace with these industries. At first with small, low pressure boilers and presently with large capacity, high pressure, highly efficient, modern steam generators. Oil producing and processing plants all over are using Erie City boilers and allied steam generating equipment in their effort to satisfy our nation's basic needs.

A new general catalog describing all of Erie City's products is available. Write for Bulletin SB-6092-L.

•You can depend on— ERIE CITY for Sound Engineering

ERIE CITY IRON WORKS • Erie, Pa.

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
WASTE HEAT BOILERS • FIRE AND WATER TUBE PACKAGE BOILERS
OIL AND GAS BURNERS • STOKERS • PULVERIZERS

For more data circle 506 on Post Card

Here's a steam trap

..and for seven sound reasons:

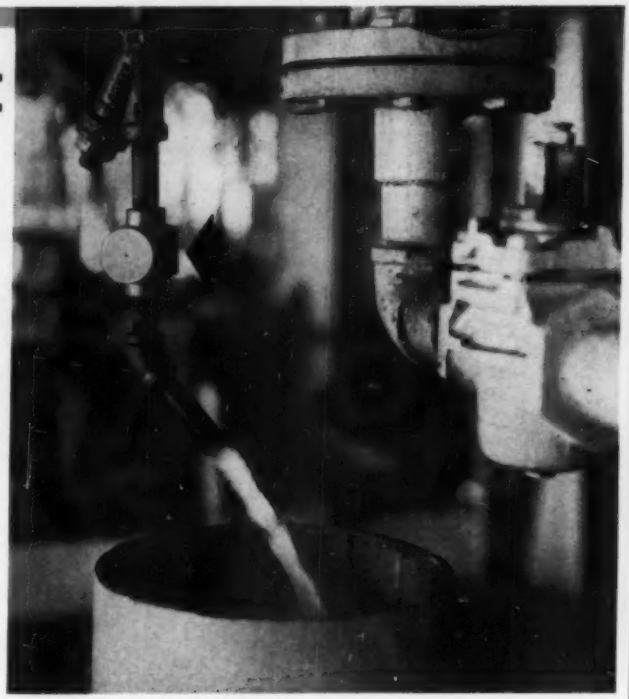
1. *Simplicity* – only one moving part.

2. *Maintenance* – practically zero. 3. *One trap* for all pressures from 10 to 600 psi.

4. *Uniform performance* – operates equally well on heavy, light, or no condensate load.

5. Operates against *back pressures* up to 50% of inlet pressure. 6. *Rugged* – unaffected by superheat, water hammer, vibration, or corrosive condensate. 7. *Minimizes inventory* of spare parts.

Sarco TD's on outdoor blending tanks of Shell Oil Company, Sewaren, New Jersey, are installed vertically, instead of in the usual horizontal position, in order to drain coils after shut-down, thus preventing freezing.



1. DRAINS AND VENTS

at start-up. Immediately rids lines of condensate and air to permit normal operation. This eliminates the need for manual opening of valves to drain the system.

CONTROL COSTS

In these days of sharp emphasis on cost control, Sarco Thermo-Dynamic TD Traps are helping plants to deliver the full productive power of every pound of steam. And because the TD has no mechanism . . . no gaskets . . . no narrow channels to clog, maintenance cost on the TD is almost nil. As one plant engineer puts it: "This TD is a cinch to install, it's no bigger than a tee fitting, and it works in any position. The TD is the one steam trap we can install and forget."

CHOOSE THE RIGHT TRAP

There's an infinite variety of applications, temperatures, pressures and loads in industrial steam piping. Sarco can help you select the right trap for every job of air and condensate removal, saving you money and down-time.

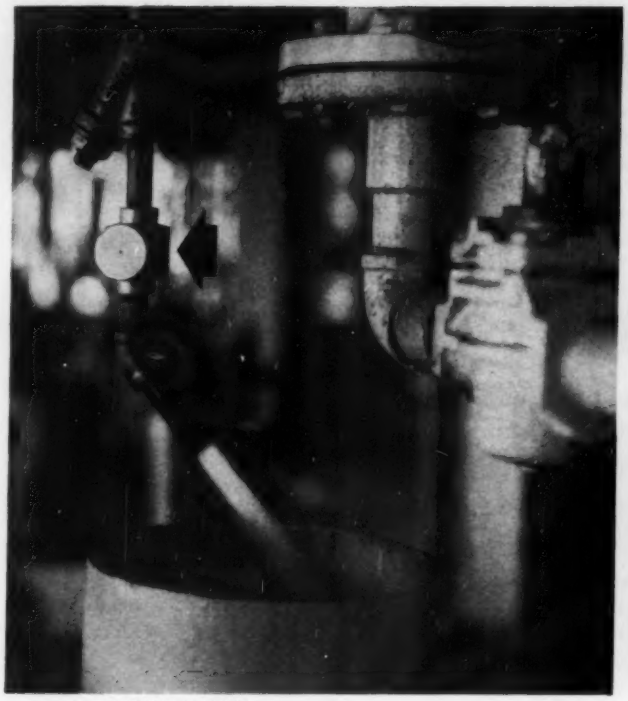
HOW ABOUT THE BUCKET TRAP?

With the development of the patented* Sarco Thermo-Dynamic Steam Trap, the bucket trap suddenly aged 50 years. In a nostalgic way we feel somewhat sorry, because *our* Sarco bucket trap has made us thousands of friends. But frankly, it's no match for the new Sarco TD. Progress is progress.

Some of our customers who are getting satisfactory service from our bucket traps may prefer to replace their old Sarco bucket traps with *new* Sarco bucket traps. If you feel this way, we're flattered enough to keep on making Sarco Bucket Traps – strong, sturdy and durable as ever. Let us suggest, however, that you at least give the new Sarco Thermo-Dynamic Steam Trap a try, under your most exacting conditions.

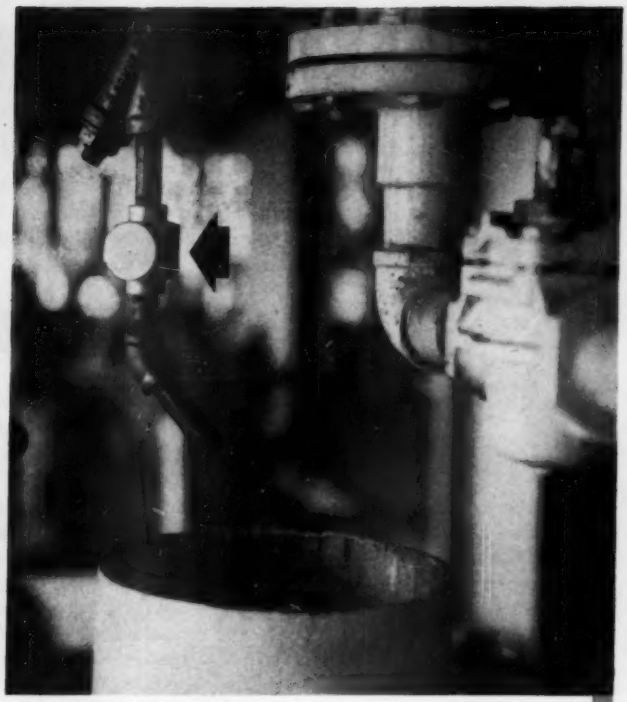
*U.S. Pat. No. 2,817,353 T. M. Reg. U. S. Pat. Off.

that does what a steam trap should



2. DISCHARGES

air and condensate at steam temperature as rapidly as they collect. Does not wait for a bucket of steam to leak through a small orifice.



3. CLOSES TIGHTLY

There is no continuous bleed; nor is there loss of buckets of steam as in the bucket trap which must discharge steam with each cycle.

MAINTENANCE TIME: 40 SECONDS!

How long does it take your maintenance crew to service an ordinary trap? If it's over a couple of minutes, you're throwing away valuable time. The Sarco TD can be cleaned, blown out, if necessary, and reassembled on the line, in as little as 40 seconds. 6345

Sarco can give you impartial advice on trap selection because Sarco makes All–5 Types:

Thermo-Dynamic . . . Thermostatic . . . Liquid Expansion . . . Float Thermostatic . . . Camlift Bucket

SARCO COMPANY, INC. 635 Madison Avenue, New York 22, N. Y.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

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HELPFUL WATER CONDITIONING DATA FROM BETZ

THE CARE AND OPERATION

■ Exchange materials should be handled with care to maintain maximum efficiency and longer service life.

With the increasing use of zeolite softeners and demineralizers in industry, the problem of keeping these units free from fouling confronts more owners and operators all the time. Rapid developments in the ion exchange materials themselves continue to stimulate their use. The economic advantage of softening and demineralizing can be rapidly lost, however, if the units are not operated efficiently.

Bacterial Fouling

Municipal and industrial water supplies contain organic and mineral matter, some of which is filtered out when the waters are passed through zeolite softeners. The bacteria counts of many raw supplies are very high, particularly surface waters that are not prepared for human consumption. The bacteria encountered are chiefly soil organisms including such types as sulfate reducing bacteria, iron bacteria and various spore formers. Coliform bacteria are found occasionally in private well supplies.

Zeolite beds, in general, cannot support growth of bacteria in themselves. The organic matter that is filtered out by the zeolite, however, provides a source of food for reproduction of bacteria. Many times the pH, temperature and other environmental conditions in the softener are ideal for stimulating growth. Water with a low bacteria count can become heavily contaminated in passing through a badly fouled softener.

Bacteria produce slime which is voluminous and adherent and cannot always be removed by the action of regeneration and backwashing. The growths of slime and bacteria can impart objectionable taste and odor to the water. Even when the taste and odor are not objectionable, the slime can cover a significant portion of the zeolite so that regeneration is partially ineffective.

Surface supplies, to a greater extent than well supplies, contain high molecular weight organics. The organics, besides acting as food for bacteria can be of the type that slowly diffuse into the structure of the zeolite. Because the outward diffusion will be just as slow, the normally short regeneration period usually will not remove this type of fouling. The organics, in badly infested water, can build up and result in deterioration of some zeolites.

Other Deposits

Iron, aluminum, and manganese deposits are often encountered in zeolite softeners. Deposits of this type coat and penetrate into the zeolite particles reducing the exchange capacity of the unit. The coated particles can gradually increase in size resulting in large, hard masses and channeling of the softener bed. The channeling is very undesirable since it permits leakage of hardness during a softener run. In addition, the fouling becomes progressively worse as the effectiveness of the backwash is decreased.

At one particular plant, short softening runs developed after the zeolites had been in use for several years. Inspection revealed that the top six to eight inches of the softener bed was almost a completely solid mass. To break through the solid top layer a heavy crow bar was necessary. Below the solid layer large round balls, some eight inches in diameter, were found. Very little of the bed was in its original condition and it was difficult to believe that any softening could be accomplished by the unit. This case is undoubtedly an extreme one where the combination of a poor quality influent water and insufficient backwash rate made a premature replacement of the zeolite necessary.

Iron is probably the chief mineral enemy of zeolite material. Iron exists in various forms. In water supplies, such as deep wells, where oxygen is not present, iron exists in the ferrous state. In this form, iron is very soluble and can be exchanged as readily as divalent calcium and magnesium (the common hardness ions) in a softener.

If the water supply is aerated before softening, ferrous iron is oxidized to the insoluble ferric (trivalent) form. When ferrous iron is oxidized and there is insufficient time for its removal prior to softening, the insoluble ferric iron will not be exchanged by a zeolite but will be filtered out. For this reason, where it is necessary to soften a well supply containing iron, the softener should be located near the well and every effort made to keep air from entering the system. Preventing air leakage is sometimes impossible and it is often safer and cheaper to remove iron in an aerator or a special iron removal filter before softening.

Operational Factors

Mineral and bacterial accumulations cause an increased pressure drop across a softening unit. Flow rates can be decreased and pumping power requirements can increase. If fouling material is not removed at regular intervals, the exchange capacity of the softener can be permanently decreased. Increased quantities of regenerant are then necessary. The length of time required for backwashing and the quantity of backwash water is often increased. Rinsing is less effective in a badly fouled softener.

It should be kept in mind that a heavier fouling potential is imposed on softeners as the exchange capacities of the synthetic zeolite materials increase. That is, a unit of high capacity exchange resin generally filters a great deal more water between backwashes than the same unit of greensand. It becomes increasingly important, therefore, that close attention be given to the backwash and regeneration operation. If the period between regenerations is more than 24 hours and the quality of the influent water is inferior, or pressure drop across the unit is higher than normal, backwashing at more frequent intervals without regeneration will prove helpful.

Fouling of the softener can and often does lead to other disadvantages as well. Besides shorter softener runs, higher salt consumption and greater loss of zeolite mineral, the quality of the effluent will decrease with time. Where the softened water is used as makeup to boilers, internal treatment consumption will be

OF ZEOLITE SOFTENERS

TABLE I CHARACTERISTICS OF CATION EXCHANGE MATERIALS

Type of Material	Capacity gr. per cu. ft.	Regenerant lb./kgr.	Operating pH	Range Temp. °F.
SILICIOUS BASE				
Processed Greensand	2,500- 3,000	0.35-0.50	6.0- 8.4	135 Max.
High Capacity Greensand	5,000- 5,500	0.35-0.50	6.5- 8.1	110 Max.
Synthetic Gel	7,500-10,000	0.33-0.50	6.8- 8.2	100 Max.
ORGANIC				
Sulfonated Coal	6,000- 7,000	0.45	5.0-10.0	135 Max.
Polystyrene Resin	20,000-30,000	0.25-0.50	5.0-11.0	250 Max.

increased, a heavier accumulation of sludge will develop and increased blowdown rates will be necessary. Very frequently, excessive periods of rinsing must be used before a good quality effluent is produced, which is low in both hardness and chlorides.

Tables I and II list the common types of exchange materials used in zeolite softeners together with their exchange capacity and other operating characteristics. This information can be used as a guide in checking the operation of the zeolite unit to determine whether its efficiency has decreased. A daily log on softener operation should be maintained to accumulate the necessary data to permit checking of the softener efficiency.

TABLE II FLOW RATES IN GALLONS PER SQ. FT. PER MINUTE

	Back-wash Rate	Regen. Rate	Rinse Rate	Oper. Rate
SILICIOUS BASE				
Processed Greensand	9	2.5	5	5
High Capacity Greensand	9	2.5	5	5
Synthetic Gel	4-6	2.5	5	5
ORGANIC				
Sulfonated Coal	6	1.5-3.0	2.5-6	6
Polystyrene Resin	6	2.5	2.5-7	7

The anticipated loss of exchange material is a maximum of 3% per year due to mechanical breakdown. With fouling this loss can be seriously increased. While the zeolite mineral is not a capital expense but rather a maintenance item, it nevertheless is important to minimize the cost of operation and a comprehensive program should be followed to assure minimum loss of resin, maximum salt efficiency and the continuous production of a good quality effluent. Such a program will pay dividends.

To assure efficient operation of the softener, the following items should be checked:

(1) Quality of the influent water.

(2) The backwash rate and quantity of backwash water used.

(3) Quantity of salt used per regeneration.

(4) Quantity of water softened between regenerations.

(5) Quantity and flow rate of water used for rinsing.

(6) Periodic examination of the softener and exchange material.

The correction of the problem may involve better clarification of the influent water. In some cases, revision of the backwash, regeneration or rinsing cycle or improvement of the distribution system may be necessary. Perhaps a periodic chemical cleaning with special cleaning agents may be all that is necessary.

However, if permanent damage has been done to the resin, then replacement of the material will be necessary. When replacements are necessary, the selection of one of the high capacity resins to replace greensand or the silicious type zeolite can often lead to substantial savings in salt requirements. Table I shows the comparison between capacity and salt requirements for various types of exchange materials. It should be noted that greater exchange capacities can be secured with the polystyrene resins at a lower salt consumption than with the greensands. It should further be noted that the polystyrene resins can tolerate a wider variation in pH and temperature. In many cases, the softening rates are higher with these materials and increased capacity can be an added benefit. The replacement of natural greensand with a polystyrene resin has resulted in as much as a 40% increase in softening rate and as high as a tenfold increase in softener capacity. The savings in both salt and labor attributed to operation of the softener can result in sufficient savings to pay for the replacement in less than two years.

A BETZ Field Engineer will be pleased to discuss your zeolite softener problems, review operating conditions and offer recommendations for the proper mechanical or chemical correction to assure maximum efficiency. Should replacement of the bed be necessary, he will be pleased to recommend the proper BETZ Resin for your requirements.

BETZ LABORATORIES, INC.
Gillingham & Worth Streets • Phila. 24, Pa.

BETZ

■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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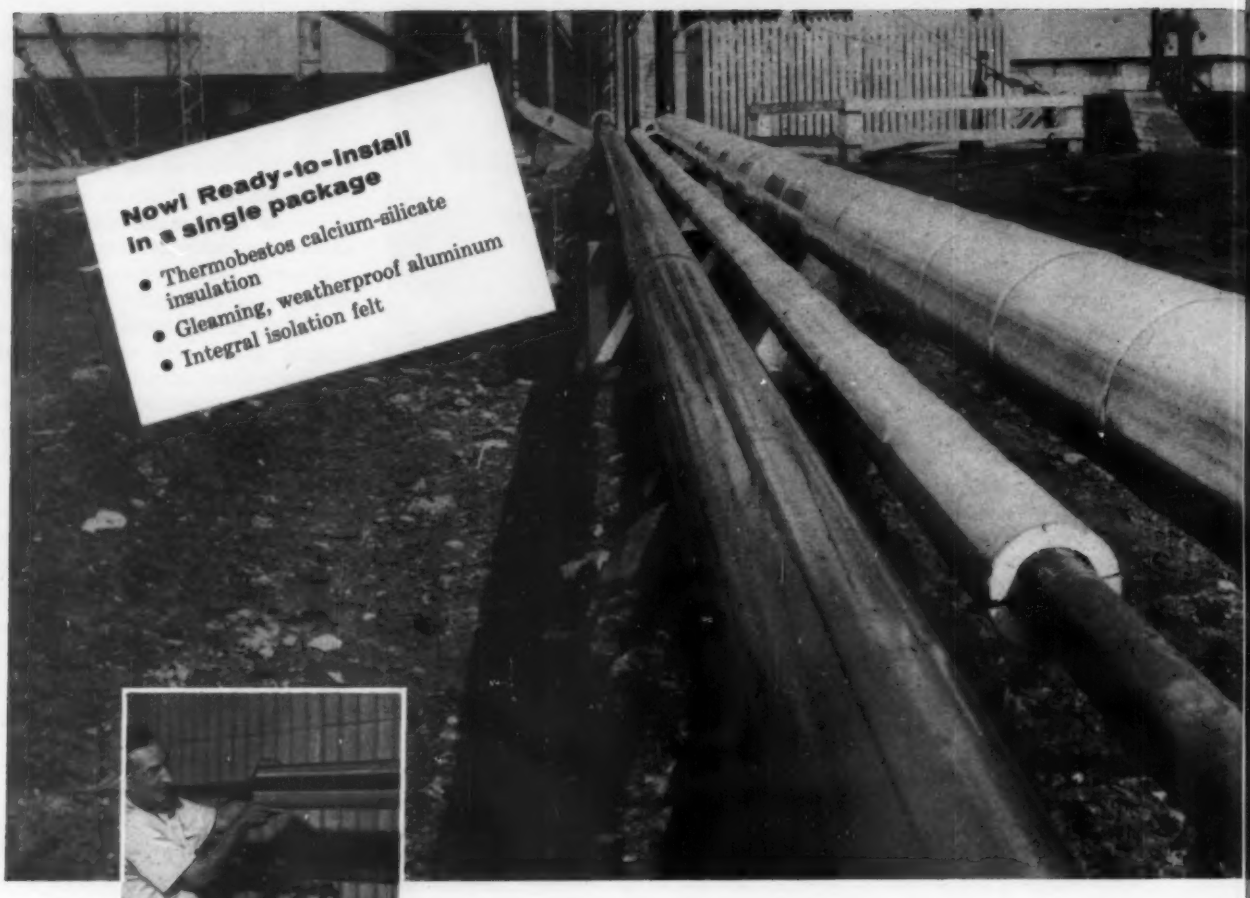
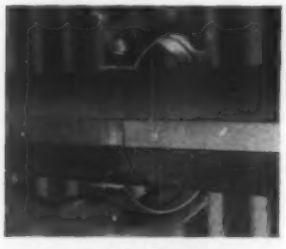


Remove from carton and Metal-On is ready to install. Just snap on pipe and lock in place.



...the specially designed aluminum "snap strap" (containing vapor seal) is snapped on joint...

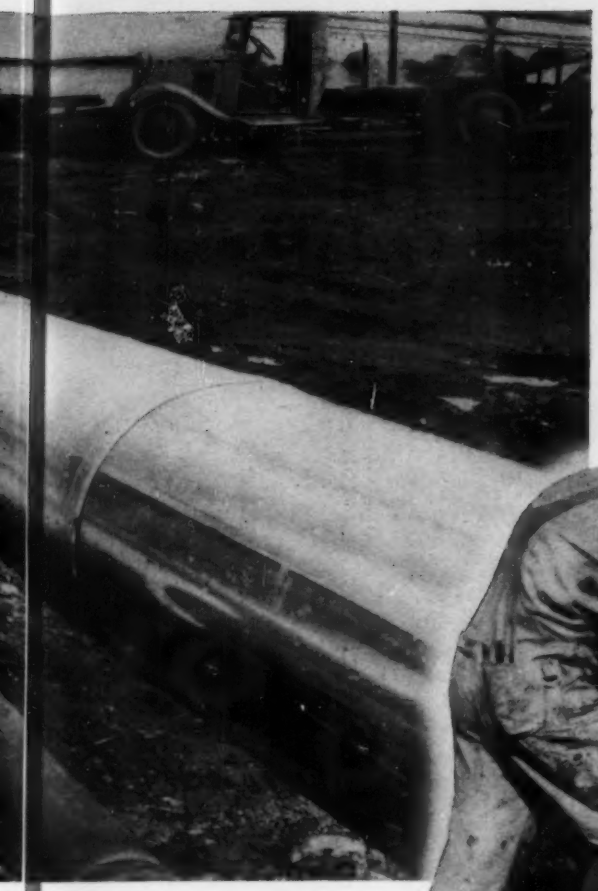
... Metal band completes the assembly ... provides perfect joint protection against vapor and weather. Available in many colors, the Metal-On band also serves color coding purposes.

Two men completed 660′ Metal-On

New Johns-Manville Metal-On insulation is today's fastest and most efficient way to install high-temperature pipe insulation... and protective metal jacketing

Metal-On is still new! It is just months since its introduction—yet it has already been accepted by virtually every industry in which high-temperature pipe insulation needs protective metal jacketing.

One reason for this rapid, all-out acceptance is Metal-On's installation economy. A single package product that consists of high-temperature insulation and protective aluminum jacket—Metal-On entirely eliminates separate on-the-job metal application. In



Part of 2100-foot Metal-On installation. New plywood plant of the Winton Lumber Co., Jackson, Cal. Insulation Contractor: Western Asbestos Co., San Francisco.

Metal-On pipe insulation presents no fitting problem. It is cut easily right on the job with either power or hacksaws. Available in long, 3-foot sections in a complete range of pipe sizes through 24" . . . by 3" thickness.

this insulation job in one working day!

fact—a section of Metal-On can be applied at least as fast as pipe insulation alone.

However important installation speed may be, it is but one Metal-On advantage! For Metal-On also ends guesswork in specifying aluminum alloys and jacket thicknesses. Its jacket measures an ideal .016" thick . . . of a high-quality aluminum alloy selected expressly for superior weather resistance . . . good appearance . . . and resistance to abuse and pitting.

Of course, Metal-On never needs painting. Won't rust. Is impervious to dirt, oils and grime. And, unlike corrugated metal jacketing, Metal-On has no dirt-collecting grooves—its smooth surface stays clean.

Metal-On also provides top fuel savings and accurate temperature control, because its insulating element is Johns-Manville Thermobestos®, finest of all the calcium silicate insulations for temperatures to 1200F. The conductivity of Thermobestos is lowest of all insulations generally used in power and process industries.

To help you compare Metal-On with the insulation you're now using—let us send you the new technical data brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y.

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JOHNS-MANVILLE JM PRODUCTS

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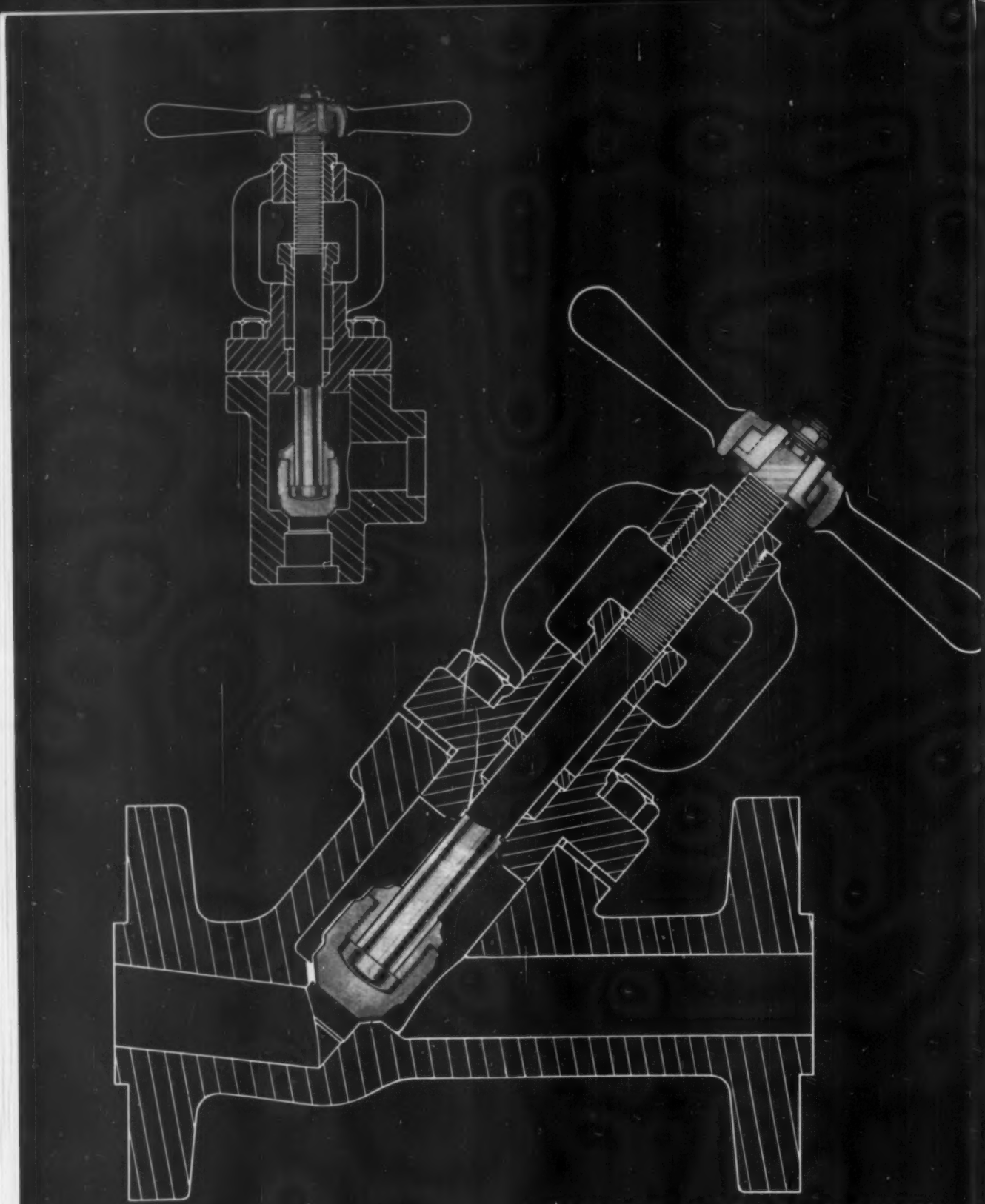


EDWARD FORGED STEEL BLOW-OFF VALVES

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Edward Drop Forged Blow-off Valves

. . . the first—and still the newest!

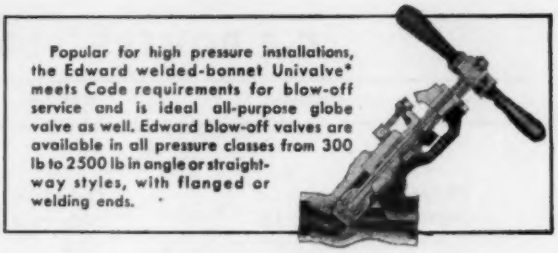
Fifty years ago, when boilers operated at 250 lb sp the first really efficient means of blowing-down was with "new" Edward blow-off valves. Today, with pressure in the 1800-2600 lb range and with water temperatures sometimes exceeding 600 F, corresponding improvements in Edward blow-off valves have been effected. For example, today all Edward blow-off valves have integral Stellite seats and Impactor* easy closing handles.

All over the world, high temperature-pressure steam power stations rely on these Rockwell-built Edward blow-off valves. The reasons are basic. Edward valves are simple and rugged in design, with no "trick construction." They operate easily, stay tight, need very little maintenance. If parts replacement is ever necessary, repairs are easier and less expensive than with any comparable valve.

The ASME Power Boiler Code requires steel valves wherever boiler drum pressure is above 200 psi . . . but, because blow-off service is severe at any pressure, operators of lower-pressure plants also have found it most economical to standardize on Edward valves.

Catalog 12-D2 tells the full story.

Recommended practice: Open valve nearer boiler first. Then slowly open other valve. After blow-off, close second valve first; then valve nearer boiler. This places greatest wear on blowing valve, assures a tight valve next to boiler, facilitates repair without a boiler shut-down.



Popular for high pressure installations, the Edward welded-bonnet Univalve* meets Code requirements for blow-off service and is ideal all-purpose globe valve as well. Edward blow-off valves are available in all pressure classes from 300 lb to 2500 lb in angle or straight-way styles, with flanged or welding ends.

Premium Features of Edward Blow-off Valves

- INTEGRAL SEAT of chromium-cobalt-tungsten alloy. Applied directly to body in a continuous ring, then machined in same set-up with bonnet guide bore for perfect alignment. Highly resistant to abrasion and corrosion.
- HARD-FACED DISK—Stellited for maximum resistance to abrasion and corrosion. Edward swivel-disk construction allows stem to lift vertically away from seat. No grinding or galling.
- POSITIVE BACKSEAT isolates packing from the high temperature zone. Line-contact backseat seals EValpak* valve packing from line pressure, permits repacking under pressure.
- IMPACTOR HANDLE, an Edward exclusive, is standard equipment. Several times more effective than ordinary handles or handwheels in opening or closing valves.

EDWARD VALVES, INC.

1202 West 145th Street, East Chicago, Indiana

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

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What's the latest in

C-E BOILERS * FOR HIGHEST STEAM PRESSURES

COMPANY	STATION	No. of Units	Throttle Pressure	Steam Temperature	Capacity—kw Total
		FOR SUPERCRITICAL PRESSURES			
Philadelphia Electric Co.	Eddystone	1	5000	1200/1050/1050	325,000
Philadelphia Electric Co.	Eddystone	1	3500	1050/1050/1050	325,000
Cleveland Electric Illuminating Co.	Avon	1	3500	1100/1050	215,000
		FOR SUBCRITICAL PRESSURES — ABOVE 2400-LB			
Metropolitan Edison Co.	Portland	1	2520	1050/1050	165,000
Metropolitan Edison Co.	Portland	1	2520	1050/1000	225,000
New England Power Co.	Brayton	1	2520	1000/1000	250,000
Virginia Electric & Power Co.	Chesterfield	1	2520	1000/1000	167,000
Virginia Electric & Power Co.	Possum Point	1	2520	1000/1000	225,000
Dayton Power & Light Co.	Tait	2	2490	1050/1000	260,000
		FOR SUBCRITICAL PRESSURE — 2400-LB			
Central Hudson Gas & Electric Co.	Danskammer	1	2400	1050/1000	125,000
Cincinnati Gas & Electric Co.	Beckjord	1	2400	1050/1000	156,250
Cincinnati Gas & Electric Co.	Miami Fort	1	2400	1050/1000	156,250
Cleveland Electric Illuminating Co.	Ashtabula	1	2400	1050/1050	225,000
Cleveland Electric Illuminating Co.	Eastlake	1	2400	1050/1050	187,500
Cleveland Electric Illuminating Co.	Lakeshore	1	2400	1010/1010	225,000
Consumers Power Co.	Karn	1	2400	1050/1050	250,000
Consumers Power Co.	Port Sheldon	1	2400	1050/1000	250,000
Detroit Edison Co.	St. Clair	1	2400	1050/1000	325,000
Duke Power Co.	Allen	2	2400	1050/1000	330,000
Duke Power Co.	Allen	3	2400	1050/1000	825,000
Duke Power Co.	Lee	1	2400	1050/1000	165,000
Niagara Mohawk Power Co.	Dunkirk	2	2400	1050/1000	400,000
Niagara Mohawk Power Co.	Huntley	2	2400	1050/1000	400,000
Pennsylvania Electric Co.	Shawville	2	2400	1050/1000	330,000
Pennsylvania Power & Light Co.	Brunner Island	1	2400	1000/1000	300,000
Philadelphia Electric Co.	Schuylkill	1	2400	1050/1000	175,000
Potomac Electric Co.	Dickerson	2	2400	1050/1000	350,000
South Carolina Electric & Gas Co.	McMeekin	3	2400	1050/1000	375,000
Tennessee Valley Authority	Widows Creek	1	2400	1050/1000	500,000

* The above list covers American utilities only. Abroad, too, the C-E Controlled Circulation Boiler has achieved a predominant position for 2400-lb applications, evidenced by orders placed with C-E or its licensees for 23 units with an aggregate capacity of 5,030,750 kw.

COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

Steam Pressures?

Although one unit for supercritical pressure is presently in service and others soon will be, today's pressure plateau is in the 2400-2520 psi range.

It appears inevitable that many new units will be purchased for this pressure cycle, since it offers a heat rate gain of about 185 Btu over the 1800-psi pressure class. With ever-increasing fuel prices, there is ample incentive to move up to these higher pressures.

In the entire area of high pressures, temperatures and capacities, Combustion is playing a leading role. As indicated by the list on the opposite page, 39 C-E units have been purchased for use in the 2400-lb. pressure range and above—33 of the Controlled Circulation design. The turbine-generator capacity for the 39 units listed totals over 8-million kilowatts. Already, 16 of these units are in service supplying steam to produce more than 2½-million kw. One has been in service over 3 years.

Later this year, a C-E Sulzer Monotube unit, designed for the highest steam pressure and temperature to date (5000 psi at 1200 F), is scheduled to go into service at the Eddystone Station of Philadelphia Electric Company. Two more supercritical pressure units, for 3500 psi, are now under construction. Similar units for subcritical pressure are already in service for Metropolitan Edison Co. and Dayton Power & Light Co.

Along with higher pressure, the trend is toward higher unit capacities. In another year, the average size of high pressure units purchased should be up to 250 megawatts as compared to an average of 200 mw, for the units listed on the opposite page.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

C-218A

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

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See why ALCOA ALUMINUM makes a good design habit

Requirement: Low-cost, corrosion-resistant piping with high bursting strength

Key to good design: Specify Alcoa Aluminum alloy piping

Where product protection, corrosion resistance and high bursting strength are of foremost importance in a process, aluminum piping is the answer. ALCOA® Aluminum Pipe is the least expensive for doing the job most satisfactorily. It does not catalyze the decomposition of many sensitive chemicals as other metals do. It resists attack by materials within the pipe, as well as by corrosive environments outside. And its clean, easily maintained appearance is ideal for food processing plants where sanitary conditions are important.

With ALCOA Aluminum Pipe you also get a smooth, low friction surface, high thermal conductivity and nonsparking characteristics . . . all highly desirable qualities.

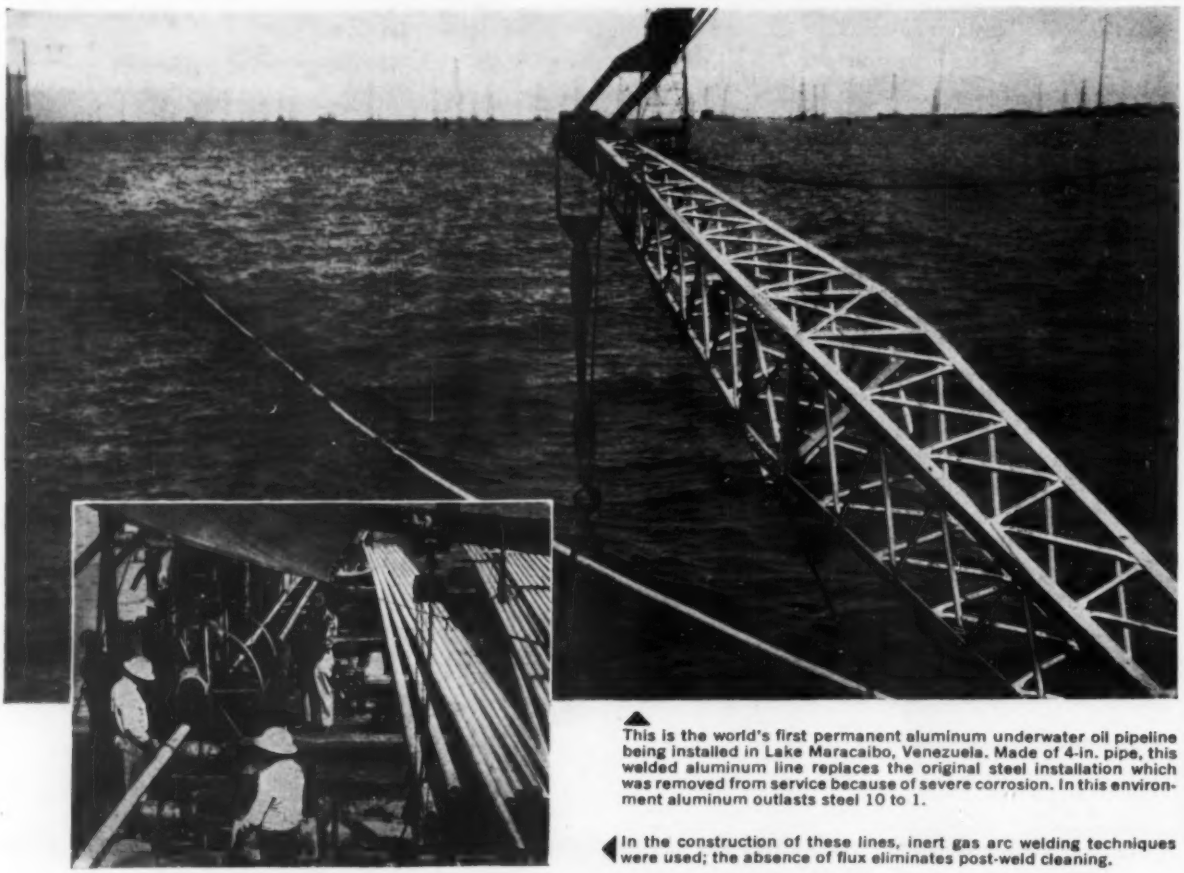
In ultra-low temperature applications, ALCOA Aluminum Pipe retains its excellent physical properties without embrittlement. Tests to as low as − 423°F show it actually grows in strength as the temperature drops. That's why it is specified for tonnage oxygen, nitrogen, hydrogen and helium service.

ALCOA Aluminum Piping is regularly produced in ASA sizes from ⅛ in. through 12 in., and in a variety of alloys and tempers, some as strong as low carbon steel. Seamless pipe in sizes up to 20 in. in diameter is available on special order.

ALCOA engineers have worked closely with all segments of the process industries for over 40 years, and can help you specify the aluminum alloy pipe best suited for your process application. ALCOA's unparalleled experience in this field is available to you for the asking. Write to the address on the coupon, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

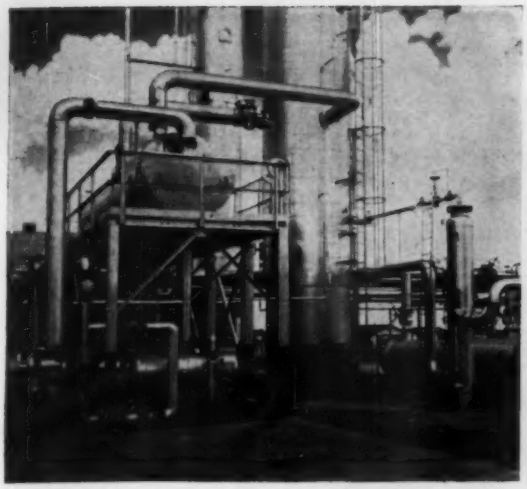
You also can take advantage of the wide selection of free ALCOA literature on aluminum for process piping and other process applications. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward your material promptly and without obligation.

During 1959, ALCOA will conduct engineering conferences in a number of major cities on process industries applications of aluminum. Contact your nearest ALCOA sales office for full particulars and dates.



▲ This is the world's first permanent aluminum underwater oil pipeline being installed in Lake Maracaibo, Venezuela. Made of 4-in. pipe, this welded aluminum line replaces the original steel installation which was removed from service because of severe corrosion. In this environment aluminum outlasts steel 10 to 1.

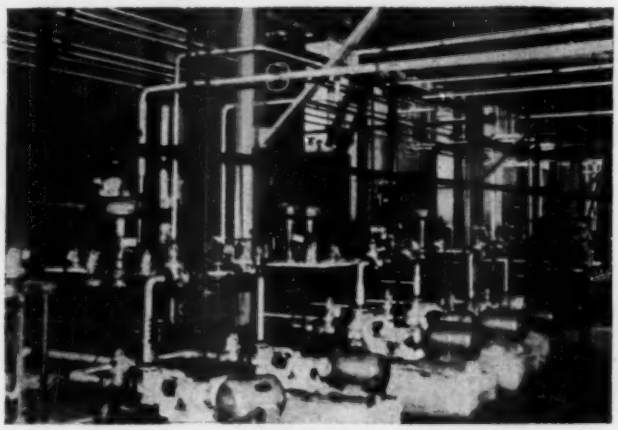
◀ In the construction of these lines, inert gas arc welding techniques were used; the absence of flux eliminates post-weld cleaning.



Corrosion and product contamination problems were solved by the use of aluminum in this processing plant. Alcoa Aluminum provides the lowest priced pipe able to resist the action of vinyl acetate and other corrosive liquids such as fuming nitric acid, hydrocyanic acid, acrylonitrile, etc.

Highly resistant to H_2S and CO_2, aluminum pipe has been proven in service in gas purification plants.

Alcoa's new UNISTRENGTH Pipe cuts cost, cuts weight with no sacrifice in bursting strength. The secret: wall thickness is reduced everywhere but at the ends where it is needed for joining. This compensates for the local reduction in strength caused by the heat of welding on popular heat-treatable pipe alloys. Available in a range of sizes with ends matching uniform wall pipe of the same size and ASA schedule number.



Naval store plants find aluminum pipe and Unitrace ideal choices because they do not discolor or downgrade resin and other pine products.

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ALUMINUM
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876-L Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature on Alcoa Aluminum for piping, fittings, and many other uses in the process industries.

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20272 Aluminum Alloys for Handling High Purity Water
- ☐ 20268 Resistance of Aluminum Alloys to Fresh Waters
- ☐ 20935 Designing to Prevent Corrosion
- ☐ 10415 Welding Alcoa Aluminum

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HELPFUL BULLETINS

MECHANICAL POWER TRANSMISSION

101 Industrial Drives — Detailed information on high speed standard industrial drives offering a maximum of selection flexibility is presented in 22-pp Bulletin 5904. Includes specifications, computing formulas, table of ratio factors, service factors, horsepower rating, outline dimensions, assembly details, lubrication schematics and photos of typical installations. Western Gear Corp.

102 Adjustable-Speed Drives — Twelve-pp Bulletin D-2507 gives detailed performance and application data on the all-electric, adjustable-speed V*S Jr. drives. Typical applications employing drives from ¼ to 4 hp, specifications, dimensions, and gearmotor selection table are given. Bulletin is illustrated with photos and cartoon drawings. Reliance Electric & Engineering Co.

103 Mechanical Drive — Six-pp Bulletin 3600 describes the Allispede mechanical adjustable speed drive which operates on a-c power, offers speed ranges up to 8:1, ratings from 1 to 30 hp. Gives engineering and applications information. Illustrates modifications to basic drive — remote controls, mounting flanges, brakes, remote speed indicators. Graphs show speed regulation benefits gained by using a synchronous induction motor in the drive. The Louis Allis Co.

104 Variable Speed Drives — Designated M-592, this 96-pp catalog explains through copy, photos and drawings the wide assortment of styles, modifications and accessories available in company's complete line of mechanical variable-speed Motodrives. It includes construction features, specifications, speed and rating tables, and pricing information. Reeves Pulley Div., Reliance Electric and Engineering Co.

105 Helical Speed Reducers — Two booklets, Bulletin J-18 and J-19, contain detailed engineering data on shaft-mounted, in-line helical and right angle helical speed reducers. Each booklet contains 24 pp of rating tables, selection procedures and other technical data. Bulletin J-19 covers shaft-mounted reducers and J-18 deals with in-line and right-angle helical drives. Hewitt-Robins Inc.

106 For Big Jobs — Vertical shaft Speedmaster gear reducers offering space and cost savings and heavy low speed thrust capacity are described in Bulletin 5908, about 16 pp. Provides selection information, dimensions, capacity data and ratings for these helical gear reducers, as well as lubrication information. Service factors for various industry applications are charted. Examples of standard and special applications are given. Western Gear Corp.

107 Helical Gear Reducers — Information on a complete line of helical gear speed reducers is contained in 20-pp Book 2751. Provides selection data on 20 reducer sizes in double, triple and quadruple reductions, and contains tables of load classes and service factors, horsepower and torque ratings, dimensions, overhung load for high and low speed shafts, and mounting arrangements. Link-Belt Co.

108 Electromagnetic Clutch — Detailed information on a complete line of electromagnetic clutches, in six series with torque capacities from 1.8 through 13,000 lb-ft, is furnished in 20-pp Bulletin 6304-1B. Provides design, specification and application data, photos, cross-section sketches, dimensions, torque ratings, and speeds. I-T-E Circuit Breaker Co.

109 More Flexible Couplings — An expanded line of Para-flex cushion couplings, from fractional to 190 hp per 100 rpm, is described in 12-pp Bulletin A669C. Of two new sizes included in the line is one capable of delivering 2000 hp at 1080 rpm. Photos, drawings and text explain design features and operating characteristics of Para-flex. Detailed tables of horsepower, ratings, prices, dimensions and service factors for many applications are provided. Dodge Mfg. Corp.

PUMPS, COMPRESSORS

110 Vertical Turbine Pumps — Featured in this product bulletin is a line of vertical turbine pumps job-engineered to suit specific applications in industry. Design and construction details are noted, and applications listed. Fiese & Firstenberger Mfg., Inc.

111 Rotary Pumps — Features and advantages of company's Series D internal gear rotary pumps designed for transferring a broad group of liquids in a wide viscosity range are detailed in this product bulletin. Construction and performance data are given, as well as dimensional data and diagrams. The Wayne Pump Co.

112 Process Compressors — Heavy duty balanced/opposed compressors for refining, chemical and petrochemical industries are featured in 46-pp Bulletin 160. Advantages of design and construction are illustrated and described, cross-sections of cylinders and detailed specifications are included. Clark Bros. Co.

113 Eliminating Explosions — Bulletin 173, 12 pp, presents recent findings on mechanism of explosions in pipelines and compressor starting air lines. Discusses research on nature of explosions and shock waves in piping, and these observations are applied to compressor air starting systems. Concludes with discussion of preventive measures for eliminating such explosions. Clark Bros. Co.

INSTRUMENTS AND CONTROLS

114 Electronic Instrumentation — Eight-pp Bulletin A-913 describes electronic control equipment with integrated building-block system components designed for process and power industries. Illustrated chart has major system components arranged functionally for given process variables. The Swartwout Co.

115 Construction Services — Bulletin 107, 16-pp, describes and illustrates company's installation thru start-up service for automation and instrumentation systems. Services include a contract organization furnishing installation drawings, installation of panels, field instruments, field interconnections, commissioning, operator orientation and supplementary instrumentation personnel where needed. Panellit Service Corp.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 117 and 118.

116 On Unit Ventilator Control — Described in this unit ventilator control application manual, about 88 pp, are manufacturer's automatic control systems for hot water, steam, gas-fired and electric unit ventilators. Actual control applications are shown on each page, covering many makes and models marketed by major unit ventilator companies. Complete cycles of operation, damper sequence charts, specifications for precise temperature control and installation data are included for each. Barber-Colman Co.

117 Mass Flowmeter — Bulletin GEA-6925, 8-pp, describes theory, operation and advantages of industrial flowmeter that measures flow of fuels, industrial liquids, and gases directly in pounds. Includes ranges, specifications and dimensions, and cutaway drawings illustrating operation. General Electric Co.

118 On Thermocouples — Catalog EN-S2 contains 50 pp of detailed information on thermocouples and thermocouple components and accessories. Lists and describes standard assemblies in protecting tubes and wells for general applications; specialized thermocouples and assemblies; and bare and insulated thermocouple wires, replacement elements, ceramic insulators, metal and ceramic protecting tubes, wells, terminal heads and extension leadwires. Leeds & Northrup Co.

119 Boiler Water Gage — Details of operation, construction and ratings of the Refragage, which uses light refraction to give black and white readings of liquid levels, similar to reflex gages, on high pressure boiler are covered in Data Unit No. 356. Jerguson Gage & Valve Co.

120 Radiation Detectors — Presented in 30-pp Catalog C93-1a is a description of the theory and fundamentals of radiation pyrometry as well as the function, construction, and application of Radiamatic pyrometers. A section on how to choose proper radiation detector is also included, and instruments for use with this type of temperature sensing element are described. Minneapolis-Honeywell Regulator Co.

121 Choosing Pulse Transformers — Designed to help in specifying low power pulse transformers, Bulletin PT-204

covers blocking oscillator applications, Bulletin PT-205 is for interstage coupling applications, and Bulletin PT-206 covers specific applications where transformer parameters are known. Characteristics of pulse transformer are discussed, applications listed, and a waveform is included. Technitrol Engineering Co.

VALVES, PIPING, FITTINGS

122 Bronze Gate Valve — Bronze gate valves designed for tough service and easy maintenance are described in Bulletin AD-2340. Two lines are outlined, the rising stem and non-rising stem, in sizes ¼ through 3 in. with screwed ends. Sizes and dimensions are included. Crane Co.

123 Flow Control Valves — Catalog 310, 8 pp, describes operating principles, design features and performance characteristics of company's mechanical feedback servo valves. Provides a schematic diagram, cutaway photo and performance curves. Includes glossary of servo valve terminology. Moog Servocontrols, Inc.

124 Adjustable Cam Valve — Catalog Sheet Section IV describes an adjustable cam, lever-operated control valve designed to maintain accurate flow-pressure drop ratios for oil, steam, water, air and gas pressures to 300 psi. It is used chiefly to control flow of fuel to a burner in response to instrument control. Bulletin presents features, operation and installation information, illustrations and performance curves. Atlas Valve Co.

125 Hydraulic Valves — Operation and application of pressure controlled hydraulic valves are covered in 20-pp Catalog 230. Discusses factors influencing correct choice of valve, such as normal spool position, operating pressure source, pilot or direct operation. Also shown are flow diagrams, pressure vs flow curves, ratings, dimensions, drawings and specifications. Rivett, Inc.

126 Control Valves — Characteristics and features of company's control valve are detailed in 20-pp Bulletin 150. The eccentric principle utilized in this valve is diagrammed and primary advantages are listed. DeZurik Corp.

127 Pipeline Strainers — Bulletin 1210-1 describes self-cleaning pipeline strainers in sizes from ¼ through 3 in. Construction features, ratings, dimensions and weights are supplied. Sarco Co., Inc.

128 Branch Connection Fitting — Six-pp Bulletin TF-1-59 contains data on branch connection fittings designed for fast, durable and economical pipe branchings. Design data given in tables. Forge and Fittings Div., H. K. Porter Co., Inc.

WATER, SEWAGE TREATING

130 For Water Treatment — Offered in 30-pp Booklet D97-2 is a compilation of article reprints on instrumentation for treatment of water and sewage. What instruments water and sewage plants use, how they are used, and their function in controlling automatically the many variables in treatment processes are among topics covered. Minneapolis-Honeywell Regulator Co.

131 Clarifiers Thickeners — Bulletin WC-123, 6 pp, on Rota-Rake water and liquid treating units contains drawings and data on main model types. These include bridge-supported and center-post designs. Provides description of Rota-Rake operation and discussion of design features, such as submerged orifice plate water collection system. Graver Water Conditioning Co.

Postage-free cards for ordering catalogs are on page 117. You may also use the cards to order literature mentioned in the ads.

BOILERS, HEAT EXCHANGERS AND TUBING

132 Smaller Packaged Boilers — Bulletin 1243 describes Power-Pak packaged automatic boilers in the 15- to 25-hp range for low pressure steam or hot water heating. These units include integral oil, gas or combination firing equipment control and safety features. Tells features contributing to boiler room economy. Includes dimensions, weights, ratings. Orr & Sembower, Inc.

133 Automatic Boilers — Powermaster Model 3 packaged automatic boilers are described and illustrated in 12-pp Bulletin 1260. Boiler types, including gas, oil and combination gas-oil models, a specially-designed hot water boiler, and steam atomizing principle for use with No. 6 oil are included. Ratings and dimensions of all sizes given, as well as details of burners. Orr & Sembower, Inc.

134 Heat Exchangers — Radiafin heat exchangers for air and gases are discussed in Bulletin 11R. They serve power and process applications for heating, cooling, or dehydrating air and other gases. Bulletin describes and illustrates spiral-wound fins, molded neoprene bushings, housings, headers, and others. Schutte and Koerting Co.

135 Heat Exchanger Tubes — Principal features, technical information, composition and applicable specifications for manufacturer's heat exchanger tube alloys are discussed in 8-pp brochure. District sales offices and stock depots are listed. Scovill Mfg. Co.

136 Heat Exchanger Tubes — Eight-pp Bulletin TB-431 describes the attributes of company's Lectrosonic heat exchanger tubes, demonstrating how quality controlled manufacturing procedures provide for good fit in tube sheets, ease of fabrication and optimum fluid flow. Specifications and data included. Tubular Products Div., The Babcock & Wilcox Co.

137 To Trim Tubing Costs — To point up advantages of tubing vs bar stock, particularly if an alloy steel is involved, Bulletin TB-430 serves as a primer on how to cut cost by using mechanical tubing. Discusses initial cost, structural advantages of tubing, fabrication by machining, types of steel, types of tubes, procurement. Tubular Products Div., The Babcock & Wilcox Co.

COAL AND ASH HANDLING

138 Crawler Tractor — The HD-16 crawler tractor powered by the 16000 engine is described in Catalog MS-1318, 14-pp. It includes cutaway of the tractor, diesel engine's combustion chamber, track release mechanism and hydraulic dozer control unit. Matching equipment is pictured and described; attachments, listed. Allis-Chalmers Mfg. Co.

139 Pneumatic Conveying — The role of pneumatic conveying equipment in the pulp and paper industry is discussed in 16-pp Bulletin FF-26-2. Descriptions cover the handling of salt cake, wood chips, lime, soda ash, pulpknot rejects, and various clays. Photos, drawings, and specification tables are included. Fuller Co.

140 On Spiral Conveyors — Described in 60-pp Catalog 951 are spiral conveyors and fittings for meeting practically any requirement and operating condition. Four principal types — helicoid, sectional flight, ribbon flight, and cast iron — are listed along with special types. Selection tables list materials which can be effectively handled in a spiral conveyor, giving weights, loading classifications, characteristics and horsepower factors. Data on spiral feeders is provided. Also listed are unit drives, along with tables for drive selection. The Jeffrey Mfg. Co.

141 Chain Grate Stokers — Bulletin 5010MC describes features and advantages of company's heavy duty forced draft chain grate stokers. Typical longitudinal section through stoker is shown, and drawings of installations showing various boiler types included. Laclede Stoker Co.

142 Economical Ash Handling — Introduced in this bulletin is the Econo-Ash system, pre-engineered to handle 2 to 6 tons of ash per day and pre-fabricated to sell for about a third the cost of other systems. Text stresses advantages offered smaller plants by this system and explains operation. The Allen-Sherman-Hoff Co.

ELECTRICAL

143 Vertical Motors — Featured in 16-pp Bulletin 219 is detailed information on design and application of vertical squirrel cage induction, synchronous and wound rotor motors, 150 hp and up, frames 584 and larger. Bearing selection chart, comparative costs of motor type, specifications and normal torques are included, as well as cutaways showing construction and ventilation features. The Ideal Electric & Mfg. Co.

144 Turbine Pump Motors — Illustrated in color, Bulletin F-1975 introduces company's Type HV-1 Unibase turbine pump motors with Microset coupling. Shows a cross-section of the motor and explains design features. Details advantages of integral construction, and explains the coupling which permits fine-adjustment of pump impellers without shaft disassembly. U. S. Electrical Motors, Inc.

145 For Outdoor Service — Bulletin F-1953, 16-pp, describes the Holloshaft turbine pump motors for outdoor service, and explains the story behind the motors' principles of design. Design features — such as the revolutionary Lubriscope fast oil-filling lubrication system — are illustrated and explained. Cut-away view of the motor, with call-outs to features are included. U. S. Electrical Motors Inc.

146 For Molded Case Breakers — Twelve-pp Bulletin GEA-6757 describes company's line of industrial molded case circuit breaker accessories and modifica-

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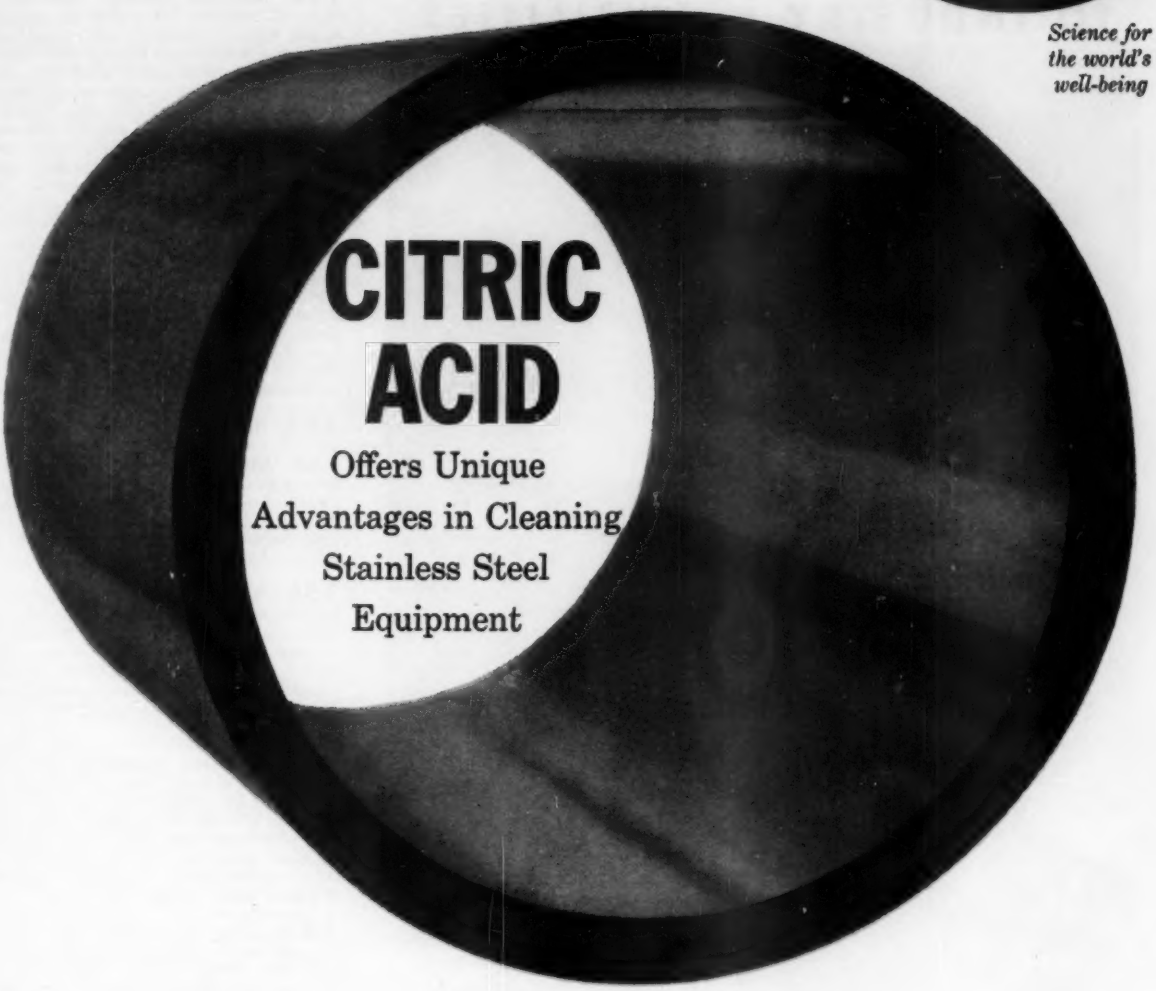

For chemical cleaning of stainless steel equipment such as boilers, heat exchangers, atomic reactors and chemical processing equipment, citric acid is the product of choice. Now, by using citric acid (which is chloride free), you can be sure *of safe, efficient cleaning with reduced after-rinsing.* Citric acid has a history of proven success.

Here are the unique advantages of Pfizer Citric Acid that you can discuss with your chemical cleaning service company:

1. Citric acid is highly efficient in removing imbedded metal and oxide film from stainless steel.

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3. Citric acid cleaning completely eliminates the possibility of chloride stress corrosion.

4. Citric acid can be effectively inhibited without losing its cleaning or sequestering ability.

5. Citric acid is sold as a dry, 100% acid—meaning savings in storage and handling.

6. Citric acid is water soluble, easy to handle, and non-toxic.

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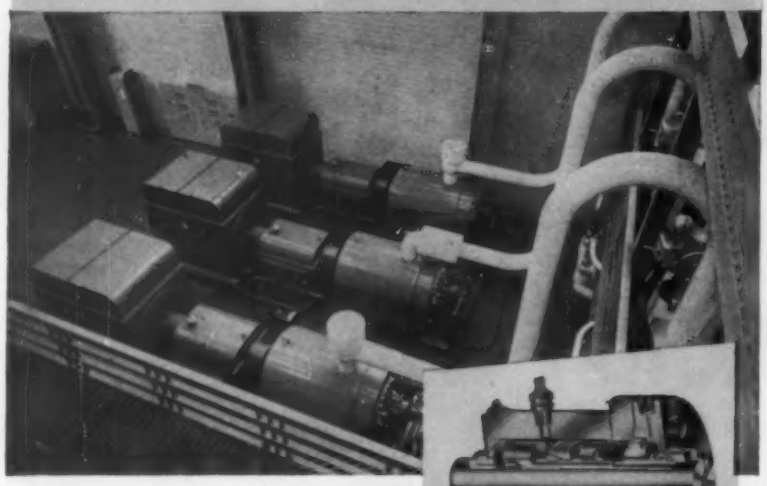
are BRINGING NEW ECONOMY TO INDUSTRY and UTILITIES



It will be worth your while to get full information about "John Crane" Seals for your high temperature, high pressure boiler feed pumps. At numerous installations they are setting records in the saving of maintenance, feed water and kilowatt costs.

Get detailed data by requesting our Bulletin S-230. At the same time we will give facts and figures on installations now in operation.

On letterhead request, we will furnish a complete layout to meet your pump requirements. Give us make, model and serial number of your pump, plus temperatures, suction and discharge pressures.

Important Economies for Other Hot Water Service, Too!

If you are operating a power plant, boiler room, industrial or commercial hot water pump system, Bulletin S-230 can help you. Contents include full details on hot water shaft seals that offer the same cost savings as boiler pump feed seals.

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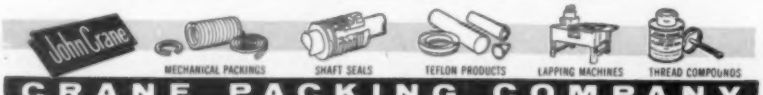

CRANE PACKING COMPANY

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tions. Provides information necessary to select, specify and order. Products are illustrated and text is supplemented by outline dimensional drawings. General Electric Co.

147 **Reduced Voltage Starters** — Eight-pp Bulletin GEA-6860 defines reduced voltage starters, tells when and where to use them and how to select them. Contains starter selection table and comparison table for determining which starter best suits the application. Illustrations show the manual autotransformer, magnetic autotransformer, primary resistor, and part winding starters, and schematic connection diagrams are included for each. Brief text stresses advantages of the line. General Electric Co.

148 **Magnetic Starter** — Illustrated and described in 16-pp Bulletin 14-B1 is a line of magnetic starters featuring simplicity of construction and maintenance. Cutaway views showing details are included, as well as application information, ratings, wiring diagrams, and selection data. Furnas Electric Co.

149 **Safety Switches** — Front-operated light, standard and heavy duty safety switches are presented in 8-pp Bulletin 502. Contains information necessary for specifying and ordering safety switches, including dimensions, capacities, voltages and horsepower ratings. Frank Adam Electric Co.

150 **Small Basic Switches** — Catalog 63 contains 20 pp of detailed information on a line of small basic switches for a variety of industrial applications. Describes features and applications, and includes photos, diagrams and specifications. Micro Switch, Div., Minneapolis-Honeywell Regulator Co.

151 **Printing Demand Meters** — Bulletin GEA-6892, 8-pp, describes printing demand meters for precision recording of loads. Discusses application, design, and cost of PD-55F and PD-57F meters. Also includes operating, construction and electrical specifications, and dimension diagrams of units. General Electric Co.

152 **Tips on Connectors** — Although small enough to fit in a billfold, this little 36-pp booklet gives about 25 time-saving applications of company's Pres-Sure connectors for solderless wire splicing and terminating. Illustrated with over 70 drawings, gives easy-to-follow examples of jobs that can be done with just one hand crimping tool. Includes chart of wire combinations approved by UL and CSA. Buchanan Electrical Products Corp.

153 **Portable Test Sets** — Featured in 8-pp Bulletin SB-OCR-1 are portable test sets for oil circuit reclosers. Operation details of the test sets are given, as well as specifications and overload capacity curves. Multi-Amp Electronic Corp.

154 **Battery Technology** — Bulletin GB-1896 is a 36-pp handbook of technical instructions and engineering data on the care of motive power storage batteries. Covers all phases of lead acid battery theory, operation and maintenance. Captioned line drawings are included as well as changes, charging and discharging cycles, plate composition. Gould-National Batteries, Inc.

155 **Brush Maintenance** — Practical tips on brush operation and maintenance on high-current, low-voltage generators used in electrolytic processes are

how to choose a dependable controlled volume pump

STUDY the specifications of a typical controlled volume pump and you can quickly judge its accuracy . . . corrosion resistance . . . even controllability. But you'll find no specifications for dependability or low maintenance, which may be far *more* important in determining a pump's usefulness.

Over the years Milton Roy has studied thousands of pumps, comparing design and construction with service records, in an attempt to pin down the characteristics that contribute most to dependable pumping. Most of these characteristics demand more time consuming methods of manufacture and more expensive materials than conventional designs. All of them have been incorporated into the standard Milton Roy pumps.

Alignment an absolute necessity

The pump base has more to do with good pump alignment than any other single part, yet its importance is rarely recognized by the pump buyer. Dependable pumping demands an extremely rigid and sturdy webbed base that positively resists deformation and prevents the misalignment that is sure to result. Base pads should be machined to eliminate the problems of aligning and protecting rough cast parts.

Massive pump frames are another necessary bulwark against distortion. Just as rigid bases keep motor, drive, and pump aligned, heavy pump frames keep plunger, packing, and liquid end in line. As a result, both packing and plunger wear more evenly and give longer service.

"Over-Engineering" assures longer life

Typical examples of how dependability must be built into a pump are the crank nuts. Conventional hardware often permits slight crank slippage . . . just enough to throw an undesirable strain on the pump drive. Substituting more expensive brass nuts boosts costs, but, since they can be drawn up tighter, eliminates the problem of slippage.

Other examples of "over-engineering" that extend pump life include generous bearing surfaces that far exceed permissible minimums . . . self lubricating connecting rod bearings . . . special gear tolerances that eliminate grinding wear, vibration, and noise . . . and high cross head length to diameter ratios to absorb unavoidable abuse without injury. Furthermore, the surface of the pump must be protected with a resistant coating as protection against corrosive fume and splash.

These three Milton Roy pumps have been feeding phosphate solution to the boilers of a major East Coast brewer for twelve uninterrupted years. Aside from periodic lubrication and examination, the total cost of parts replaced in that time is just $18.00 . . . twelve sets of packing.

The low cost of dependability

Obviously, a pump with features like these has to carry a higher price tag than one without. But the *cost* of dependable pumping is something else again. As the caption above illustrates, savings gained through years of dependable pumping with minimum maintenance expense far outweigh any slightly higher initial cost. There's little doubt that the more dependable pump always costs less in the long run.

If accurate precision metering of liquids is one of your problems, look again to the enviable reputation more than 75,000 Milton Roy pumps have established for dependable controlled volume pumping.

Milton Roy Company, 1300 East Mermaid Lane, Phila. 18, Pa.

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Chemical Feed Systems • pH Instruments

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to clean tubes from 1/2" to 2"
QUICKLY

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

Expanding scraper and replaceable element.

Expanding brush and replaceable element.

Sectional wire brush.

Air valve for one-man operation.

ROTOJET®
Junior TUBE CLEANERS

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
147 Sussex Avenue, Newark, N. J.

For more data circle 517 on Post Card

given in 16-pp Bulletin CP-3004. Included is discussion of metal-graphite brushes used in plating generators, together with explanations of contact drop, friction, resistivity, and commutator surfacing, and section on facing-in of new brushes, dust removal, selective action, and factors affecting brush life. National Carbon Co., Div. Union Carbide Corp.

OTHER EQUIPMENT

156 Boiler Water Control — This 6-pp bulletin describes an automatic side-stream boiler water control system designed to keep boiler water crystal clear. Installation photos, flow diagrams, analysis tables, specifications, dimensions, capacities, and controls are included. Sparkler-Filtrion Corp.

157 Aluminum Jacketing — Aluminum protection for insulated lines and elbows are described in Bulletin J-1. Features of jacketing include moisture barrier, lap seal, cross crimp, six weights and two alloys. Specifications. Childers Mfg. Co.

158 Iron-Impregnated Floor — Discussed in 24-pp Bulletin Mp-4d are major features sought in the design of any industrial floor subject to heavy use, such as wear and corrosion resistance, economy, spark resistance, static-dissemination, color, easy maintenance. Photos, diagrams and text cover method of application and typical installations of the Iron-Clad concrete floor. The Master Builders Co.

159 Mechanical Dust Collectors — Recent improvements in mechanical dust collectors including a new involute design are described in 8-pp Bulletin 300. Contains detailed drawings and application diagrams of involute design and other features. Research-Cottrell, Inc.

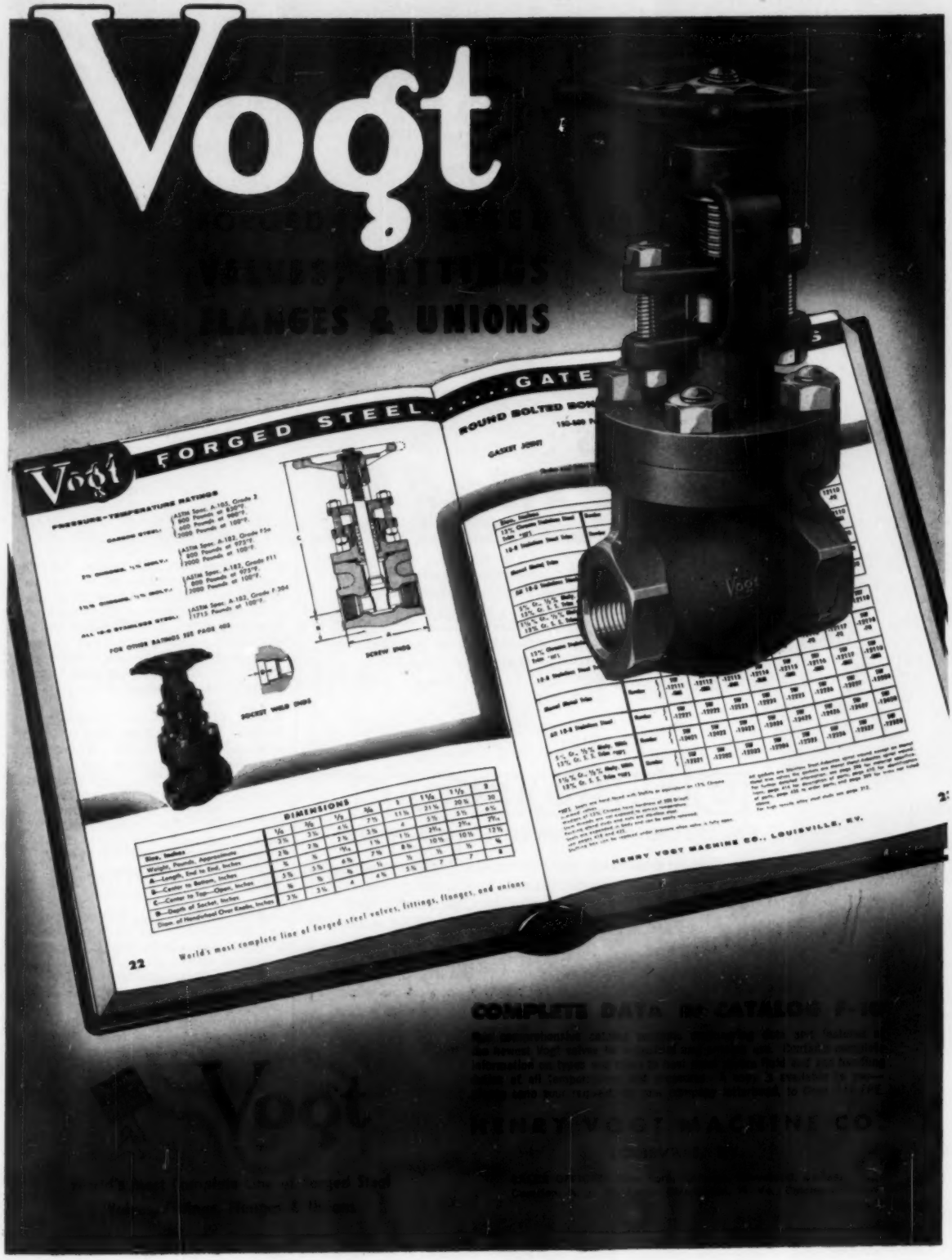
160 Industrial Gloves — Featured in 16-pp Catalog WR-459-28 is a line of industrial gloves and finger cots available in a variety of synthetic materials as well as natural rubber. Includes comparative test charts and detailed selection data. The Wilson Rubber Co., Div., Beeton, Dickinson and Co.

161 Processing Equipment — Contained in 22-pp Catalog 386 is detailed information on a line of equipment for processing of chemicals and food products, and for recovery of by-products. Mechanical details and specifications for a variety of evaporators, drum, rotary, spray and pan dryers, flakers and coolers, autoclaves, autoclave quick-opening doors, processing kettles, and gas cleaners are included. Buflovak Equipment Div., Blaw-Knox Co.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

162 Safety Color Code — This folder, illustrated in color, covers national color identification system for safety promotion and more efficient industrial production through equipment identification.

Things You Should know about



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NEW NEW

TYPE T The economy cable, Type T Dekoron Multicouple Cable consists of insulated, numbered and twisted wires covered with 90% closed No. 30 cotton braid and outer sheath of .050" thick 105°C PVC. Moisture and chemically resistant; approved for direct burial. Can be installed without conduit, or with smaller conduit when necessary.

TYPE A Same construction as Type T, above, except has outer covering of modified square lock galvanized steel armor overall which shields cable, serves as conduit and provides crush resistance with great flexibility.

TYPE AT Type AT Dekoron Multicouple Cables incorporate all advantages of Types A and T. Consists of armored Type A sheathed with .050" thick 105°C PVC. Moisture, chemical, and high crush resistance. Approved for direct burial or installation without conduit in open racks.

DEKORON®

MULTICOUPLE EXTENSION WIRE

Dekoron multiple pair harness of thermocouple extension wire is available *now* in three constructions, each in either Iron-Constantan or Chrome-Alumel. All are guaranteed to *meet or exceed ISA specs* for standard grade extension wire.

And — equally important — all are designed to drastically reduce thermocouple extension wire costs. Dekoron Multicouple Extension Wire reduces installation and maintenance time . . . often cuts initial material costs . . . *always lowers installed costs.*

A-116A

Dekoron® products QUALITY • RESEARCH • SERVICE

SAMUEL MOORE & COMPANY

DEKORON PRODUCTS DIVISION • MANTUA, OHIO

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Paint finishes are also described. McDougall-Butler Co., Inc.

163 Typing Engineering Symbols — A method of using an electric typewriter for quick, convenient typing of special symbols and equations needed in the field of engineering is the subject of this 8-pp bulletin. Describes variety of symbols which can be snapped on. Remington Rand Div., Sperry Rand Corp.

164 Vibration Mounts — Featured in this 8-pp bulletin are vibration mounts employing the principle of "rubber-in-shear" to provide vibration isolation and acoustics control. Engineering details, performance data, diagrams and tables included. Hamilton Kent Mfg. Co.

. . . *Outstanding Among This Month's Catalogs*

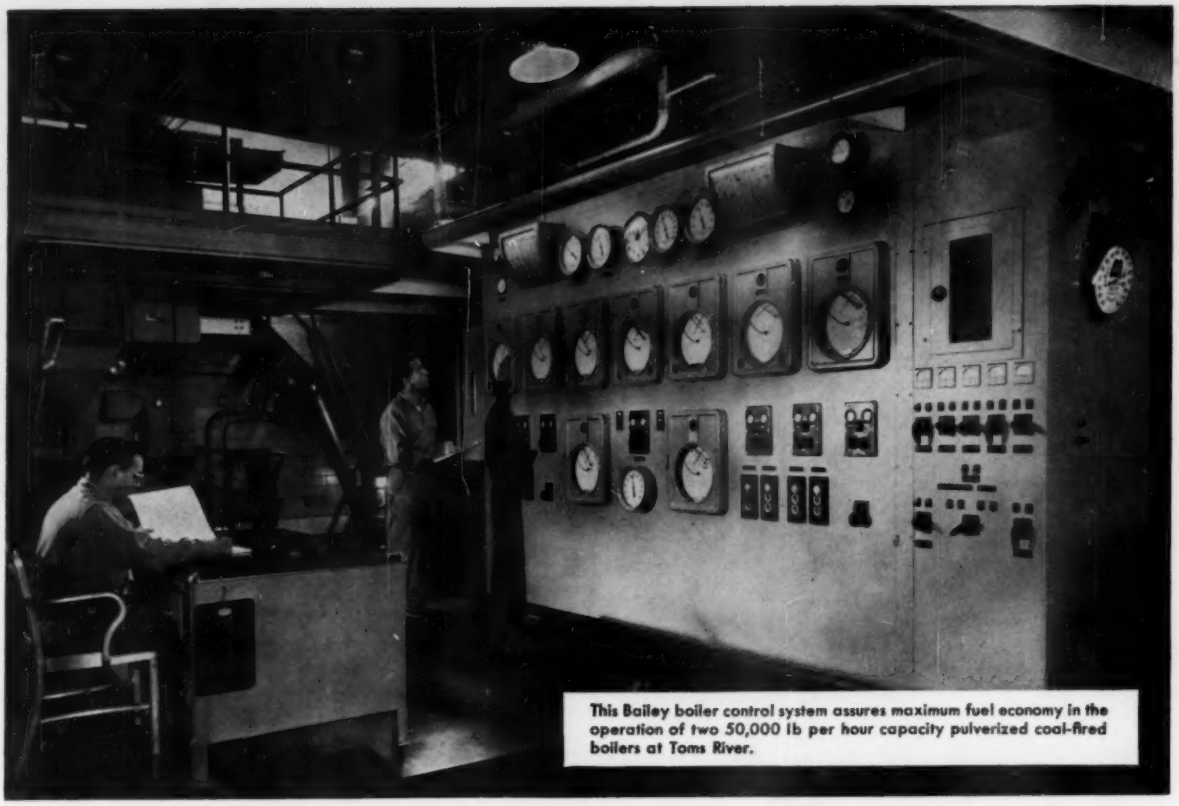
165 On Retaining Rings — Forty-pp Catalog 1216 is an engineering specification manual said to cover 80 per cent of known retaining ring applications, and includes both Spirolox and improved Circolox ring specifications. Contains application illustrations as well as information on selection of materials and finishes, design factors, charts on rotative speeds and thrust loads and typical layouts for both internal and external ring applications. Ramsey Corp.

166 Self-Lubricating Packings — This 12-pp catalog tells what Palmetto self-lubricating packings are, and discusses their advantages on pump rods and shafts and valve stems. Describes four stranded forms. Provides quick calculator tables on weights and lengths and ordering suggestions. Each of 29 packing types is illustrated and described as to recommended service, uses, temperature limits, sizes, packagings, prices. An application chart pinpoints correct packing for each type of service. Greene, Tweed & Co.

167 Chain Link Fencing — Booklet BI-439, 12-pp, lists complete availabilities, illustrates various fence components, accessories and discusses design considerations of aluminum fencing. Chain link fencing basically includes supporting posts anchored in the ground, fence fabric attached to posts, standard accessories used to attach, stretch, brace or finish fence fabric. Kaiser Aluminum & Chemical Sales, Inc.

168 Industrial Fans — Fundamental data relating to capacities and construction of industrial fans incorporating a universal discharge are presented in 28-pp Bulletin L-5. Included are rating tables giving volumes of air delivered, rpm, horsepower at various static pressures, and outlet velocity and velocity pressures, as well as tables of correction ratios for deviations from standard atmospheric conditions, material specifications. Lehigh Fan & Blower Div., Fuller Co.

169 Wire and Cable Terms — Presented in this 52-pp pocket-sized booklet is a glossary of wire and cable terms. Lists alphabetically common terms, expressions, and units used in the electrical wire and cable industry. Standard Wire & Cable Co.



This Bailey boiler control system assures maximum fuel economy in the operation of two 50,000 lb per hour capacity pulverized coal-fired boilers at Toms River.

How Bailey helps control STEAM COSTS AT TOMS RIVER

With a Bailey-engineered control system you can count on a high output of available energy per unit of fuel, whether you operate a small industrial boiler or a large central station boiler.

They did at Toms River — Cincinnati Chemical Corporation's plant in Toms River, N. J.! Bailey Controls help them save fuel by continuously maintaining desired operating conditions.

Most high-efficiency steam generating plants rely on Bailey because:

1. A Complete Line of Equipment

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A139-1

Instruments and controls for power and process

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more data circle 520 on Post Card

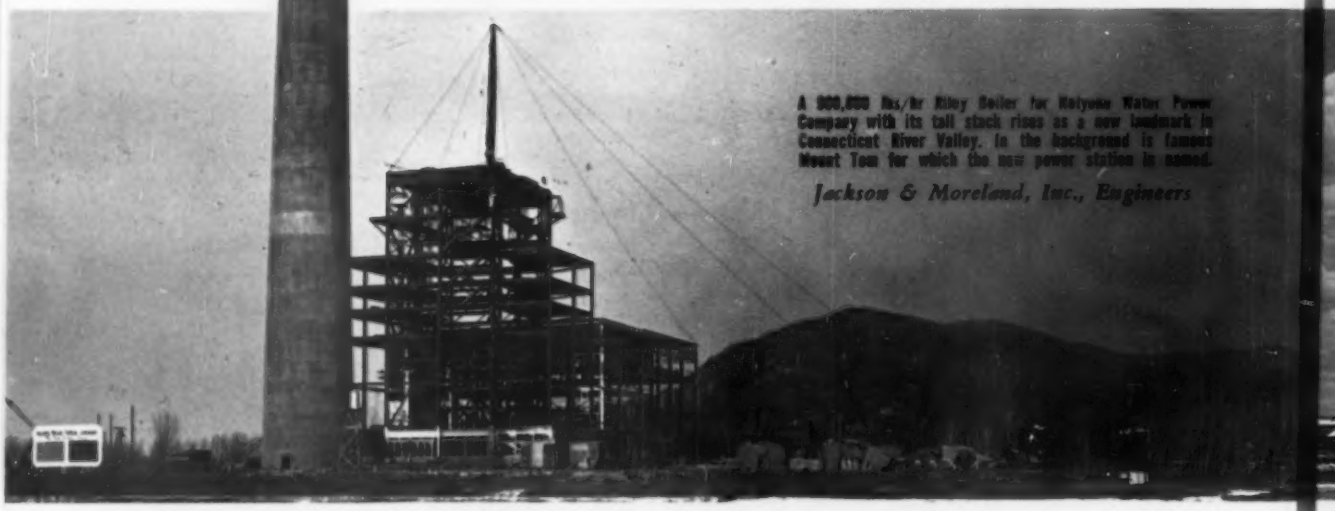
RILEY CENTRAL STATION UNITS

Landmarks From Coast to Coast

A decade of growth of the electric power industry and of Riley Stoker Corporation, one of America's leading suppliers of steam generating and fuel burning equipment, is symbolized in these Central Station installations and customers — representing a few of the many Riley Central Station Boilers that have been installed in this period of great expansion.

Now, a new era of growth is here. New Riley boiler designs and fuel burning techniques will provide the high degree of dependability and efficiency required.

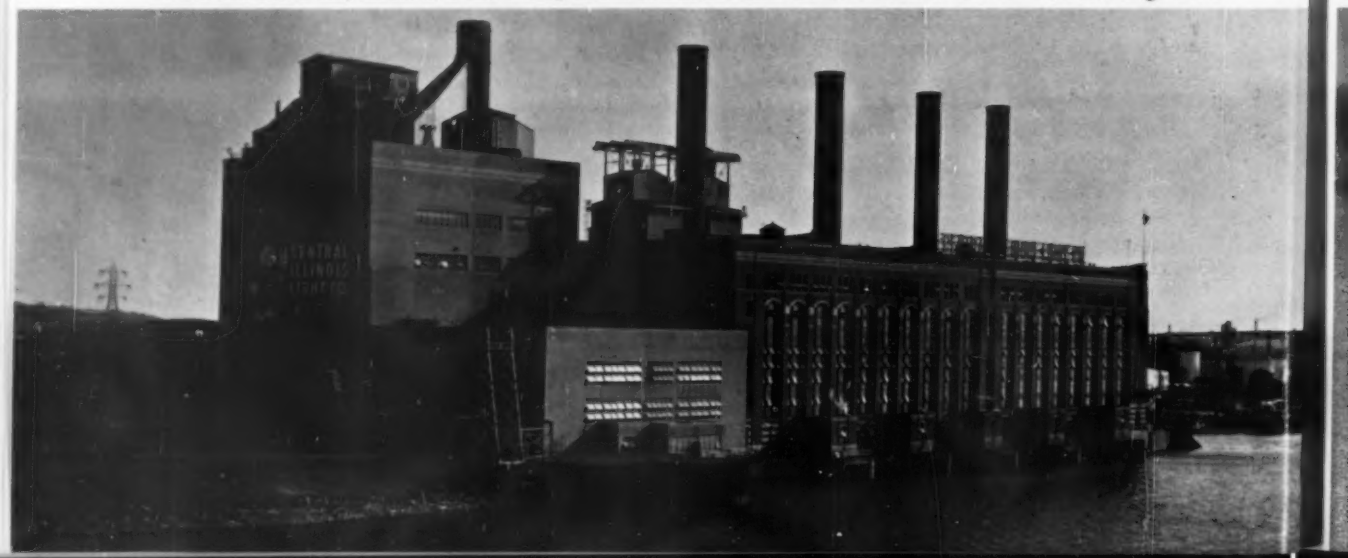
For details on the latest Riley developments consult your Riley representative.



A 900,000 lbs/hr Riley Boiler for Holyoke Water Power Company with its tall stack rises as a new landmark in Connecticut River Valley. In the background is famous Mount Tom for which the new power station is named.

Jackson & Moreland, Inc., Engineers

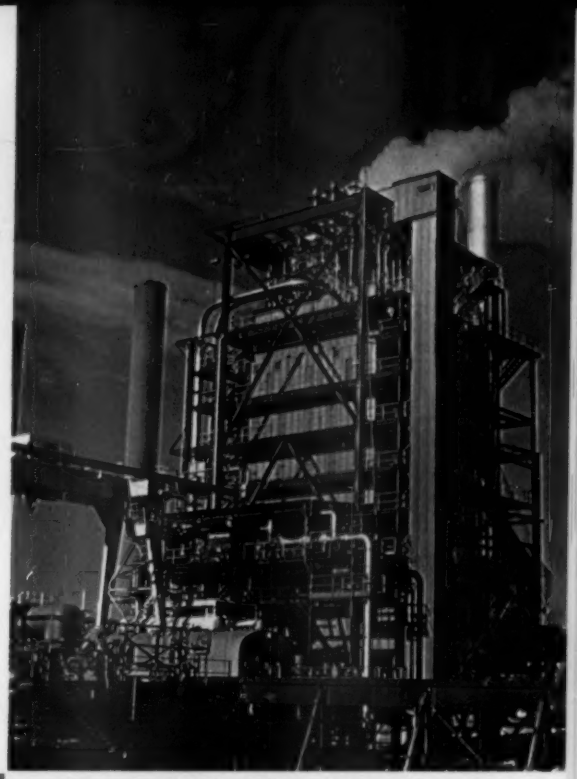
Below — Central Illinois Light Company's R. S. Wallace Station has had Riley Units installed since 1939. The latest is a 690,000 lb/hr Riley Reheat Unit. Another Riley 825,000 lb/hr Unit is being installed at LaMarsh Station. *Commonwealth Associates, Inc., Engineers.*



A Few of the Many Public Utility Companies That Are Using Riley Steam Generating Equipment

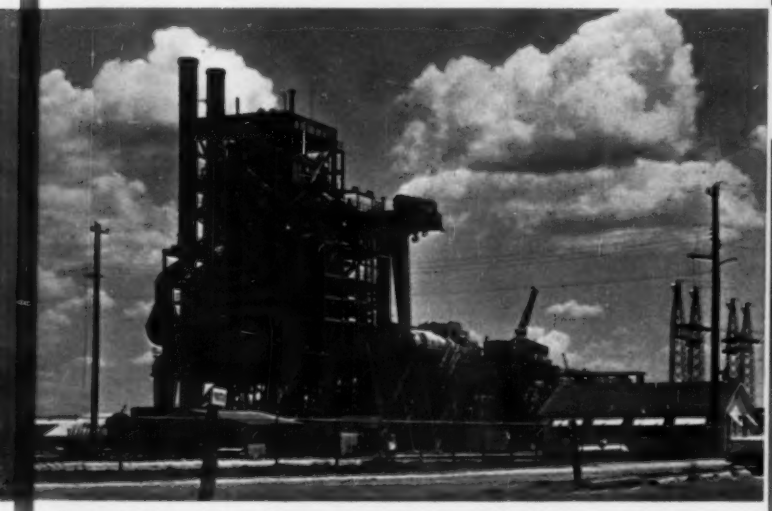
Houston Lighting & Power Co.
New Orleans Public Service Co.
Monongahela Power Company
Southwestern Gas & Electric Co.
Public Service Co. of Indiana, Inc.
Columbus & Southern Ohio Electric Co.
South Carolina Electric & Gas Co.
Northern Virginia Power Co.
Southwestern Public Service Co.
Union Electric Co. of Illinois
Taiwan Power Co. (Formosa)
Iowa-Illinois Gas & Electric Co.
Montana-Dakota Utilities Co.
Delaware Power & Light Co.
Minnesota Power & Light Co.
Central Louisiana Electric Co.
The Hartford Electric Light Co.
Manila Electric Company
Union Electric Co. of Mo.
Ohio Edison Company
Public Service Electric & Gas Co.
Dallas Power & Light Co.
Texas Electric Service Co.
Louisiana Power & Light Co.
Potomac Edison Co.
West Penn Power Co.
Arkansas Power & Light Co.
Utah Power & Light Co.
Florida Power Corporation
Florida Power & Light Co.
Central Illinois Light Co.
Southern Nevada Power Co.
Northern States Power Co.
Commonwealth Edison Co.
Gulf Power Co.
Pennsylvania Electric Co.
Interstate Power Co.
Philadelphia Electric Corp.
Kansas Gas & Electric Co.
Pacific Gas & Electric Co.
Holyoke Water Power Co.
Mississippi Power Co.
Worcester County Electric Co.

A survey of your plant by qualified consulting engineers could show ways of making substantial savings in your power costs.

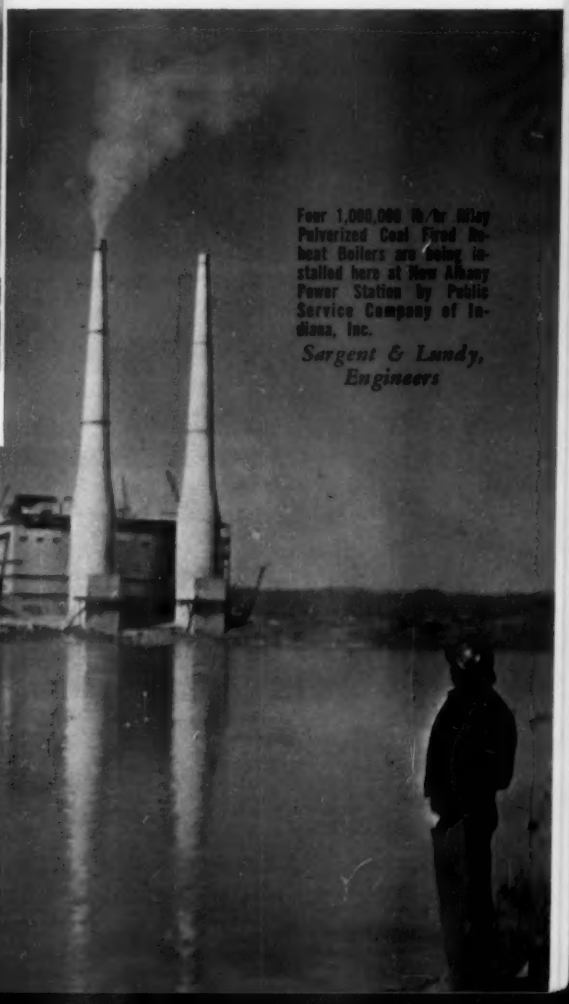


Above — The 870,000lb/hr Riley Turbo Furnace Unit at the Permian Basin Steam Electric Station of Texas Electric Service Co. which has two other Riley Units in its system.

Ebasco Services, Inc., Engineers



Houston Lighting and Power Company has installed twelve Riley Boilers in the past twenty years. Here is a recent installation at the North Houston Steam Electric Station.



Four 1,000,000 lb/hr Riley Pulverized Coal Fired Reheat Boilers are being installed here at New Albany Power Station by Public Service Company of Indiana, Inc.

Sargent & Lundy, Engineers

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASS.

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St Louis, St. Paul, Syracuse, Worcester.

"When I order salt, I want salt—not salt and a lot of sludge!"

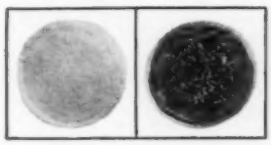
Buy Purex Salt—it's sludge-free!

You get what you want when you order Morton Purex Salt. It's the high-purity, economical, evaporated salt that's 100% soluble. None of your purchase price or freight bill goes toward paying for insolubles or sludge that are often present in ordinary salt.

What's more, Purex, unlike common granulated salt, is made in a controlled-particle size to prevent packing and channeling in brinemaking equipment.

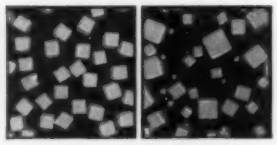
Brine tanks never need cleaning out

With sludge-free Morton Purex Salt, you prevent costly shutdowns for maintenance . . . save time and completely eliminate labor costs for cleaning out brine tanks, and you end the problems associated with dissolving salt of uneven particle size. Purex can be used in bulk wet-storage systems and in both the regular and the new fiber-glass Morton Model-E Brinemakers.



Purex **Ordinary Salt**

These filter pads (approximately 1/6 actual size) compare the amount of insolubles in 5-lbs. of ordinary salt with 5 lbs. of Purex. Morton Purex contains no wasteful sludge or insolubles.



Purex **Common Granulated Salt**

This close-up view shows you how Purex Salt, compared to common granulated salt, is more uniform in size, helping to prevent packing and channeling in brinemaking equipment.

For more information about Morton Purex Salt and for free, expert help on water-conditioning or brine-making problems, write or wire:

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. PE11, 110 No. Wacker Drive, Chicago 6, Illinois

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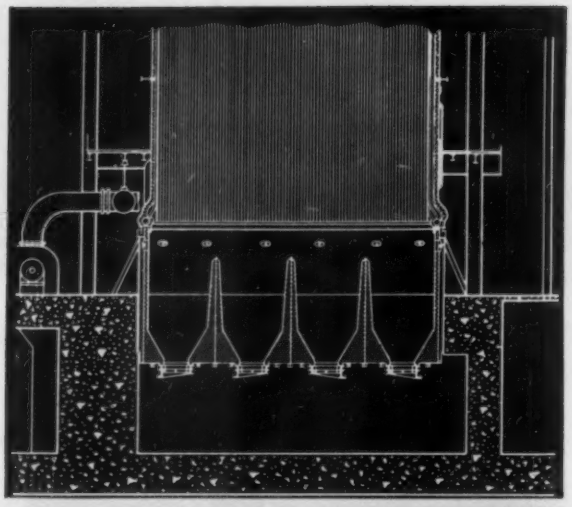
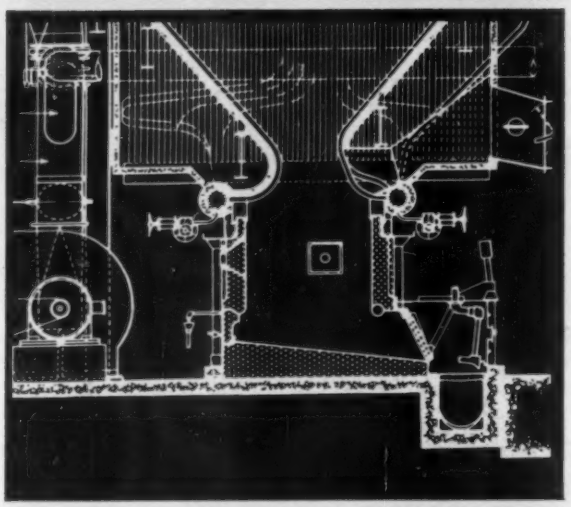
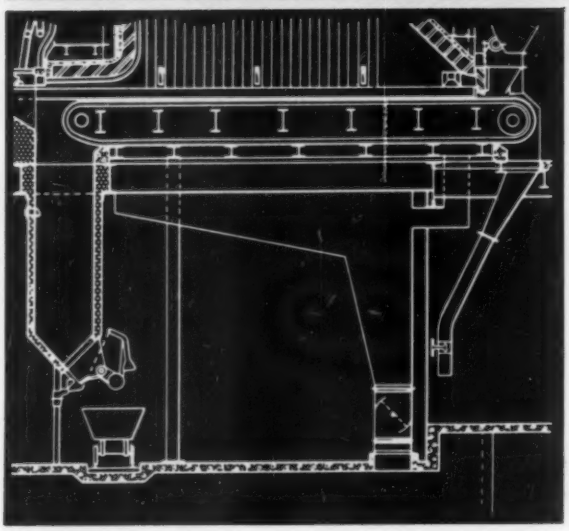


Erosion, due to dry ash sliding down the hopper, is the big problem in this ashpit.



Water jets can cause abrasion of ashpit floor refractories, and water splattered on the walls may cause spalling.



Continuous deposits of ash from a stoker-fired boiler have an abrasive effect on this ashpit lining.

Reduce refractory wear in ashpits with B&W Kaocrete

Relining ashpits is expensive. That's why power engineers specify heavy-duty B&W Kaocrete-D. On job after job, in all types of ashpits, this refractory castable has withstood the heavy abrasive and erosive attacks of sprays, jets, rakes and shovels.

The reason? Specially designed B&W Kaocrete-D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It also saves time because it can be cast or gunned in place.

For the facts and figures on Kaocrete-D, as well as Kaocrete-A which is recommended for less severe applications, consult your local B&W Refractories Engineer.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

R5C8

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide B&W Ramming Mixes • B&W Kaowool

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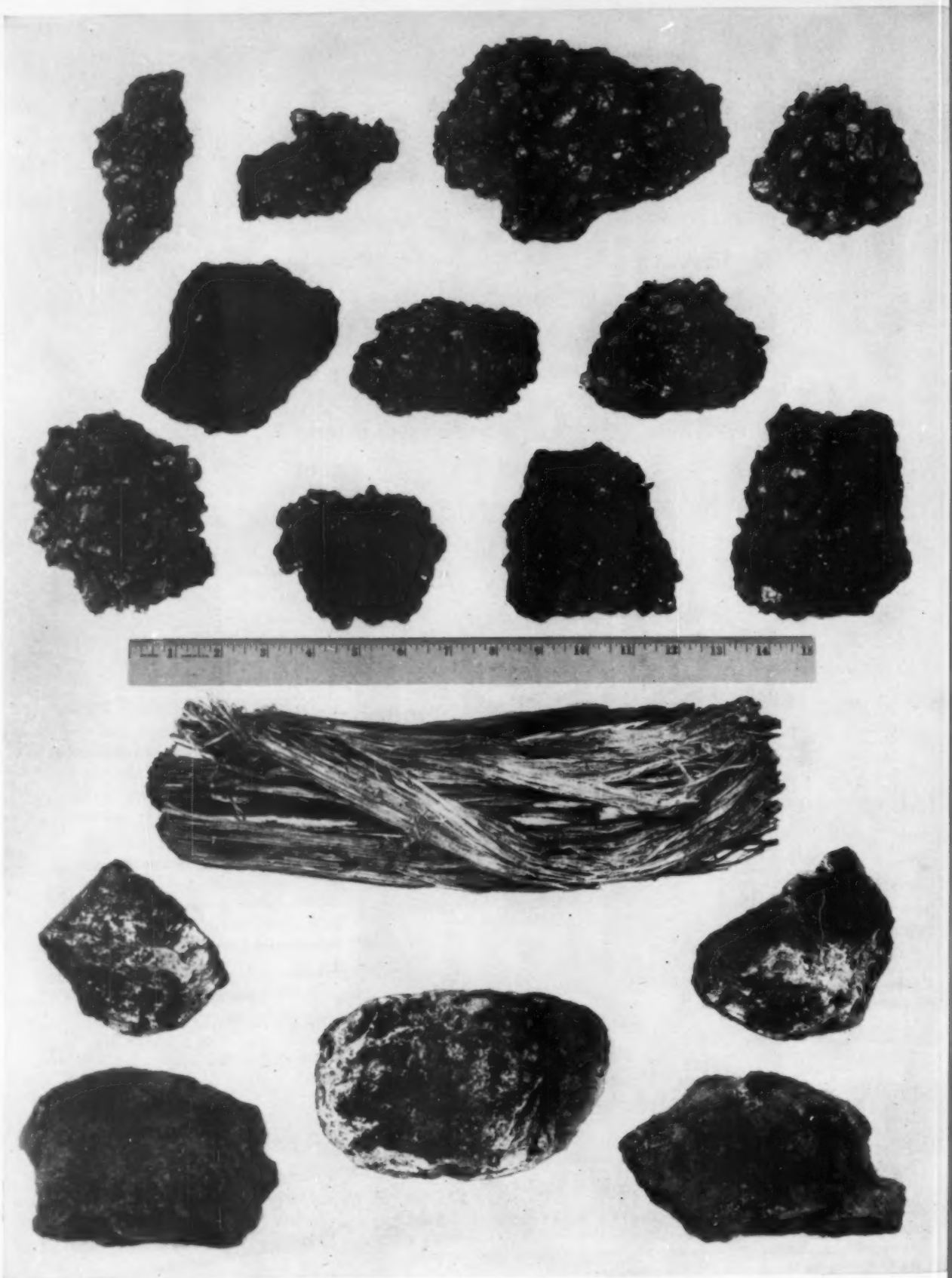

Once in a while...

something big comes along. Maybe it's a piece of wood or ball of pyrites or a chunk of frozen coal. Even in the best managed plants it happens occasionally. When it does, you have a right to expect the feeders to your pulverizers or cyclone burners not to plug or jam.

S-E-Co. *Volumetric Feeders* and S-E-Co. *Gravimetric Feeders* are built to assure reliable operation no matter what comes along. The full 24" width of coal stream from inlet through to outlet and the fact that the coal is carried on a heavy duty belt contribute to this ability. The samples of frozen coal, wood, and pyrites you see on the opposite page are just a some of the oversized objects that have come through S-E-Co. feeders without interrupting the flow of coal.

Of course you don't want to feed your pulverizers or cyclones a steady diet of wood and pyrites. What you do want is a steady, well controlled flow of coal. Even fine, wet, sticky coal is duck soup for S-E-Co. feeders.

In your next boiler specification include
S-E-Co. Volumetric or Gravimetric Feeders

Write for bulletins.

STOCK Equipment Company
723 HANNA BUILDING • CLEVELAND 15, OHIO

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New from Hills-Mc Canna Company

Now...A Packless Metering Pump*

SEND for our new specification sheet with full data on the Masterline Packless Metering Pump #903

HILLS-McCANNA COMPANY
4620 West Touhy Ave. • Chicago 46, Ill.

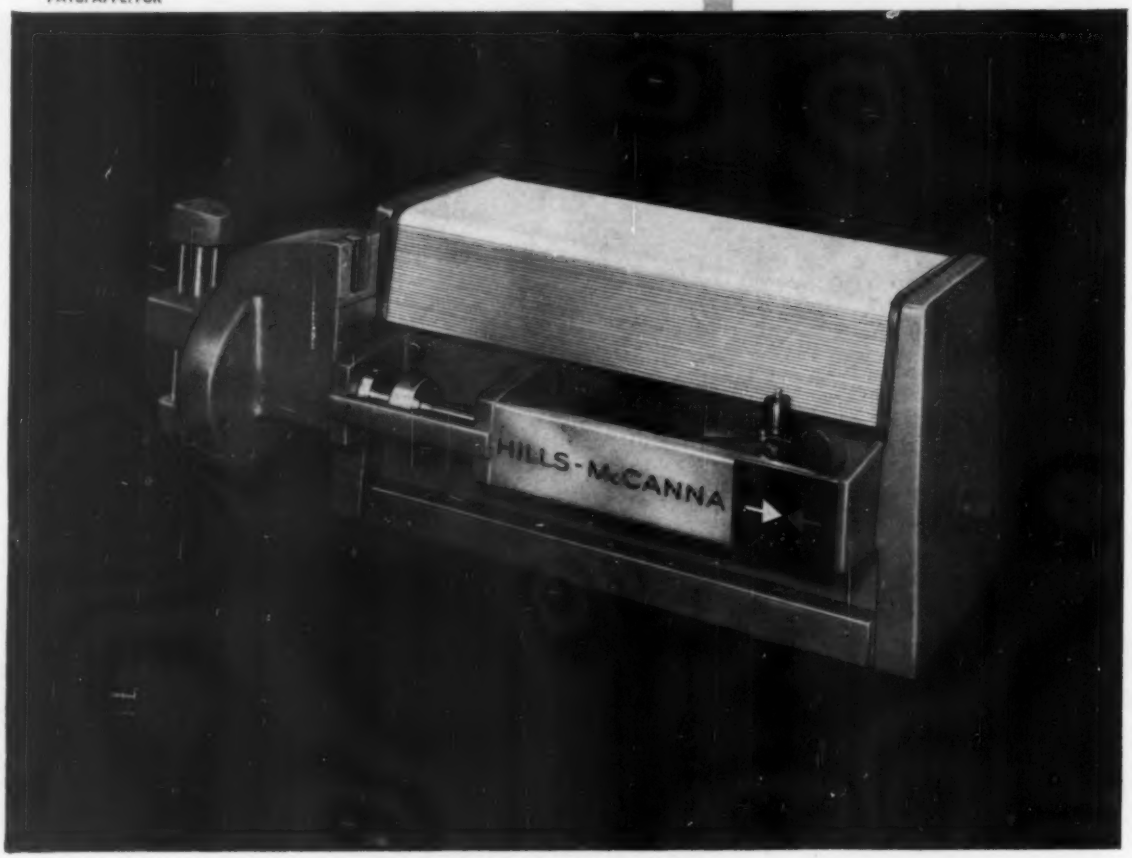
See us at the Chemical Show Nov. 30-Dec. 4
Booths 1173, 1174, 1175, 1176

ACCURACY! ECONOMY! DEPENDABILITY!
Proven Masterline Design!
Eliminate Costly Down Time and Maintenance with These Unique Features

- Packless Liquid End Construction
- Flooded Suction Not Required
- Constant Volumetric Displacement
- Design Eliminates Entrained Air On Hydraulic Side
- Built-in Safety Relief Valve
- Interchangeable With Standard Masterline Liquid Ends
- Plus All Regular Masterline Features: Simplified crank drive, pre-tested accuracy, sturdy construction, separate motor and speed reducer, adaptable for automatic or remote control . . . everything to insure dependable operation at lowest maintenance cost.

*PATS. APPL. FOR

hills~ mc canna company



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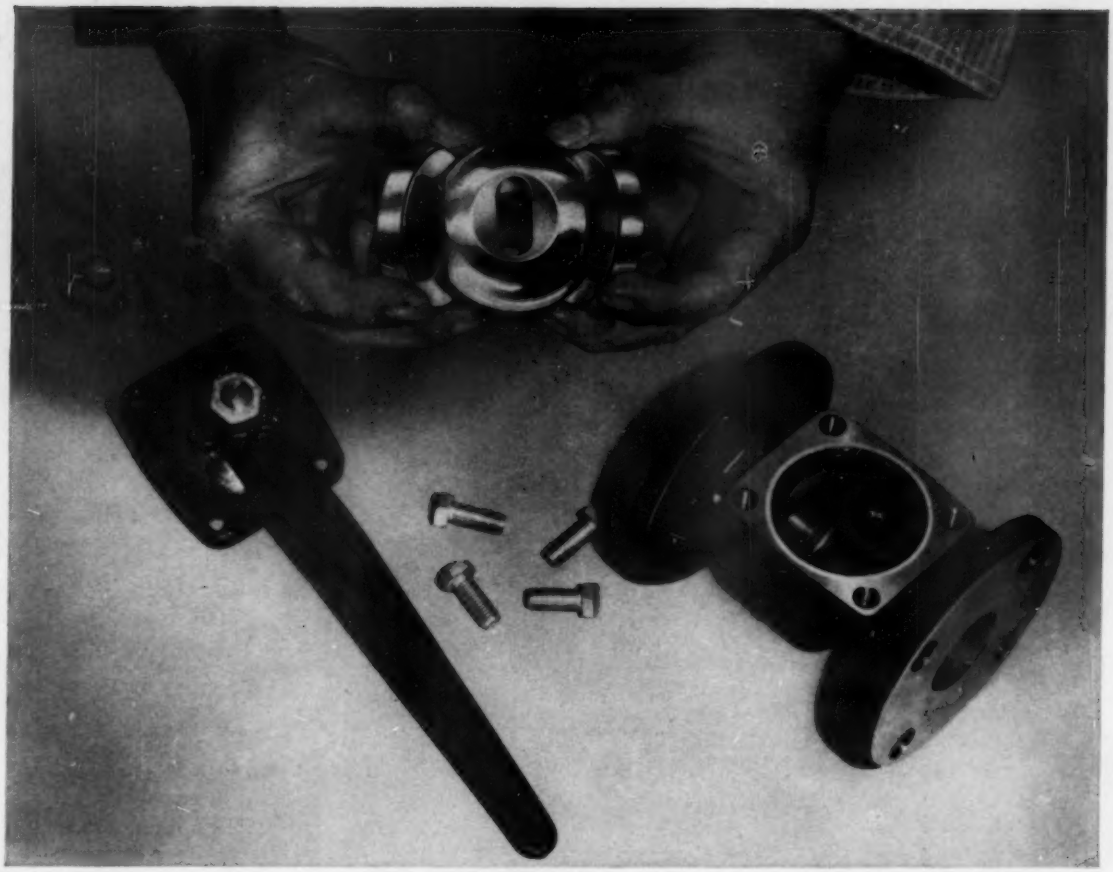
New from Hills-Mc Canna Company



Now a BALL VALVE* with all the features you've wanted

Thirty years of leadership in valve manufacture now brings you the Hills-McCanna Ball Valve! It offers every advanced feature to help you cut costs, step up production, reduce maintenance, and improve product quality.

- *Drip Tight Shut-Off*
- *Self Adjusting Seats For Extended Valve Life*
- *Top Entry For Easy In-Line Maintenance*
- *Quick Opening*
- *Minimum Pressure Drop*
- *Two-Way Flow*
- *Reduced Maintenance Cost*

*PATS. APPL. FOR

Save money!...solve valving problems ...send for free booklet describing the complete line of Hills-McCanna Ball Valves. Send for your copy of booklet #1100.

HILLS-McCANNA COMPANY
4620 West Touhy Ave. • Chicago 46, Ill.
See us at the Chemical Show Nov. 30 • Dec. 4, Booths 1173, 1174, 1175, 1176

hills-mccanna company

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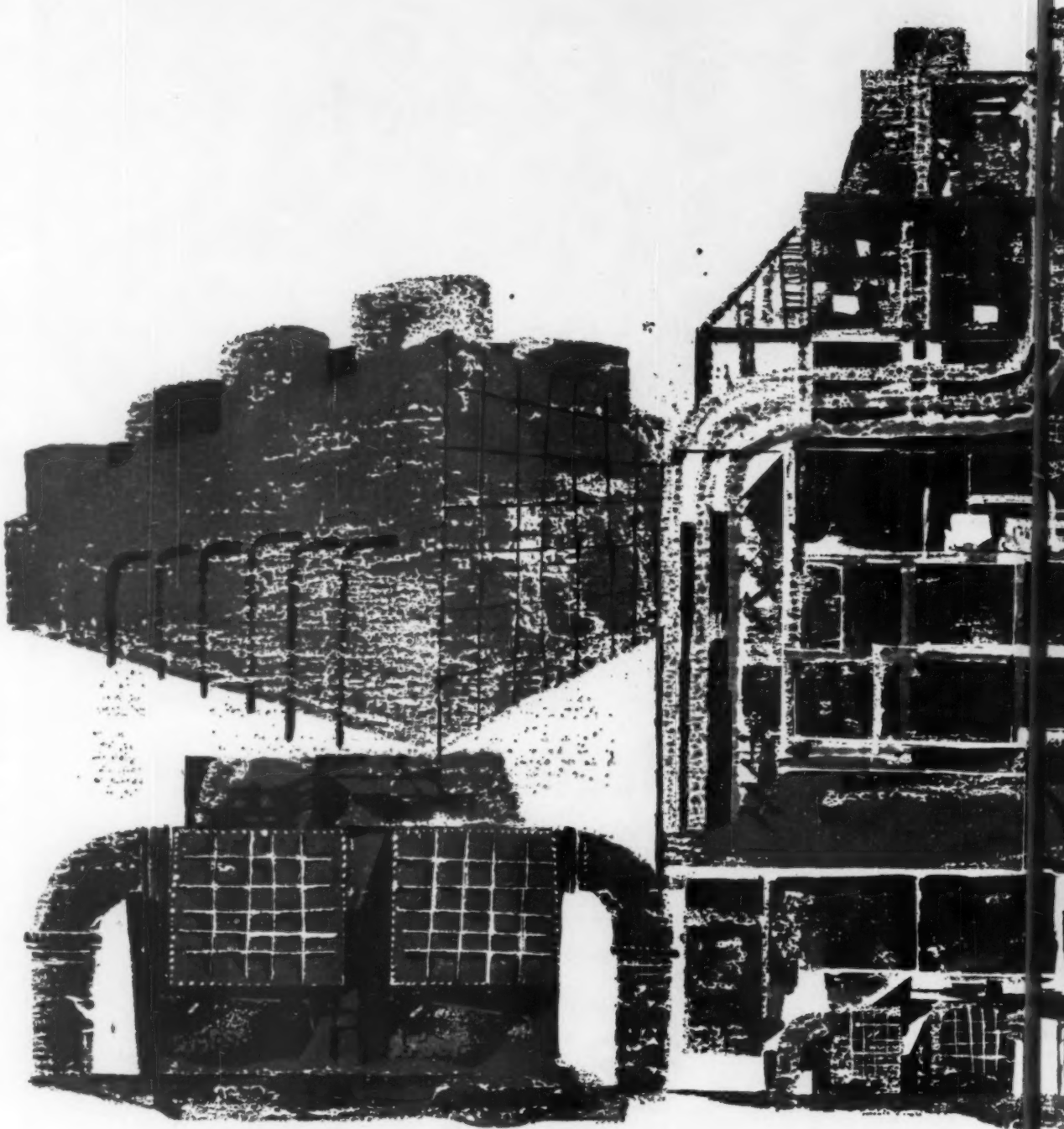
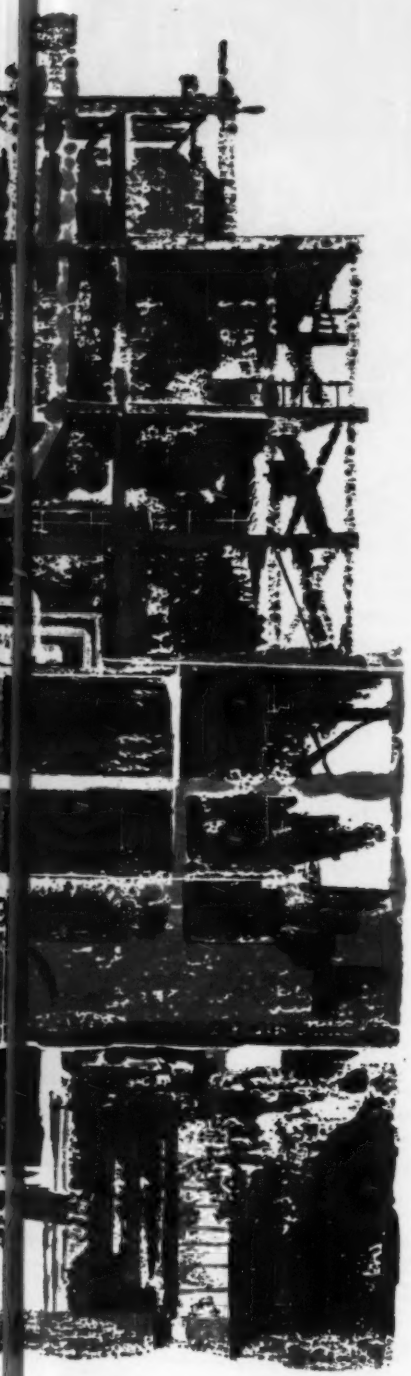


POWER PLANT PRODUCTS HEAT ENGINEERED BY FOSTER WHEELER:

Central Station and Industrial Steam Generators • Steam Condensers and Pumps • Pulverized Fuel Systems • Feedwater Heaters • Packaged Steam Generators • Cooling Towers • Nuclear Components



The one kind of engineering every plant needs

You may use heat to produce steam, electricity, or chemical reactions—but if you use it for any industrial purpose at all, heat is probably one of your major items of operating expense. There's also a good chance that heat is costing you more than it should.

That's because every piece of equipment that uses heat—be it a steam generator, heat exchanger, or simply piping—is a potential weak spot in your budget unless it is engineered to get the *optimum* out of the heat-dollars you put into it. At Foster Wheeler, getting the *most* out of heat is expressed as *Heat Engineering.*

Heat Engineering is the reason you'll see FW-built equipment in such critical places as nuclear power stations, on the world's largest and most efficient tankers and naval ships, in giant steam-electric plants, and refineries and chemical process plants of all types and sizes.

If your company is contemplating *any* modernization, expansion, or replacement where heat is concerned, why not check into the difference *Heat Engineering* can make? Contact Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

Heat Engineered products, plants and processes . . . for the world's industrial progress.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

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APPLIED EXPERIENCE

is an invaluable design factor of every

MARLEY CLASS 600 DOUBLE-FLOW

The future of an industrial cooling tower is no better than its background. Its performance and service life are dependent wholly on the practical experience and specific product knowledge of the people who design it. This suggests that you consider people as carefully as you consider price if you are to receive full-value returns from your investment.

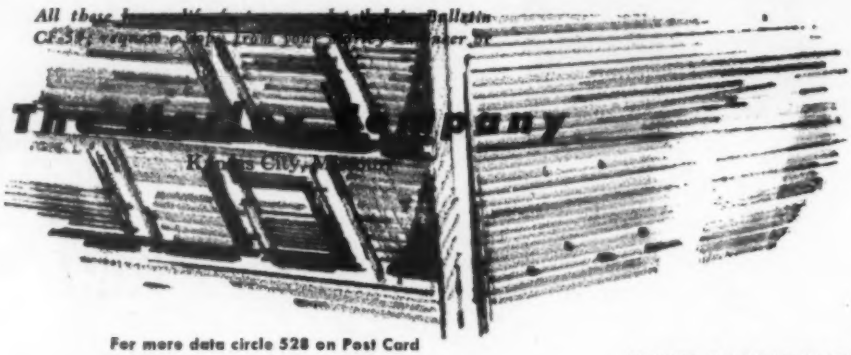
When you buy a Marley Double-Flow, qualified people and abundant experience are basic parts of your purchase. You contract for the services of the industry's largest staff of engineering specialists, and each member—from years of specialization in thermal performance, structural and mechanical design, or application economics—contributes materially to the *true* value of the product you buy.

Of equal importance is the company's overall experience gleaned from designing and building 6,854 fan cells of large capacity industrial Double-Flows in the last 21 years . . . the sound basis of all Marley engineering. The only adequate file of authentic information on cross-flow cooling is the service history of all these installations. It evaluates every advancement and innovation in cross-flow cooling and, of course, is available only to Marley engineers.

At its Research Center, the company accelerates the acquisition of experience. In this excellently equipped facility, 30 engineers and technicians intensively test and analyze materials, equipment, components, complete towers; they scientifically appraise the value of theoretical approaches to new standards of cooling performance and operating economy. From experience gained through this program, Marley develops the steady flow of design advancements that pace the industry.

The ability of Marley people to apply their extensive experience to cooling tower design is demonstrated by the results of tower tests made public annually. Year after year, they prove that Marley Double-Flows — THE ONLY TOWERS WITH A PUBLISHED RECORD OF PERFORMANCE—consistently meet the most exacting specifications of purchasers in every industry.

MARLEY



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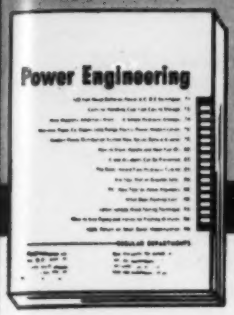

ATOMICS

308 EAST JAMES STREET
BARRINGTON, ILLINOIS

A POWER ENGINEERING FEATURE FOR UTILITY & MAJOR INDUSTRIAL EXECUTIVES

A. W. Kramer, Editor

A Periodic Report on Atomic Energy Development Throughout the World
Published by Technical Publishing Co.

November 1959

Tremendous Headache. If Madame Curie were alive today she would no doubt be quite amazed by four large volumes of Congressional Hearings recently released by the Government Printing Office in Washington. These four volumes, totaling over 3000 pages, report the hearings before the Joint Committee on Atomic Energy held this year on the general subject of Industrial Radioactive Waste Disposal.

When Madame Curie and her husband discovered radium in the early years of this century, the seemingly unending release of energy from this strange new substance was a source of universal astonishment. How was it possible for this substance to emit energy, spontaneously, year after year, without apparent diminution of the quantity of radium involved?

Today, some 60 years later, we know many of the answers to this astonishing phenomenon. We understand many of the forces inherent in the nucleus of the atom, and have been able to apply them for both the benefit and the harm of man. Today, these nuclear forces form the basis of the world-wide interest in the development of nuclear energy. During the last 15 years, as a result of this new knowledge, a new industry has arisen, bringing with it promise of virtually unlimited power for all mankind.

This new industry, however, also brings with it many new problems, one of which concerns the disposal of wastes — radioactive wastes. The solution to this problem, if there is an ultimate solution, may well be one of the most serious we have to face. Few, outside of the nuclear field, can have any conception of its seriousness or magnitude. It has been estimated that by the year 2000, when we may possibly have some 700,000 megawatts of nuclear heat capacity installed, we will be producing about 280 metric tons of fission products annually. These fission products will constitute an intense source of deadly radiation and, unless proper protective measures are taken, will remain a serious threat to the well-being of the general public for many years. At least one of the isotopes produced in the wastes — americium — has a half-life of 510 years, which means that the waste will retain some radioactivity even after several thousand years. According to this same estimate, the quantity of the single isotope of strontium-90 produced will be so large by the year 2000 that roughly 16 million cubic miles of water would be needed to safely dilute it. That is more fresh water than there is in the world, including that stored in the polar icecaps. Dr. Wallace de Laguna, who made this estimate, points out that the quantity of strontium-90 which is expected to exist by the end of the century, unless properly contained, will be more than sufficient to injure all of mankind.

This gives us at least one authoritative opinion on the scope of the problem we are facing in the application of nuclear energy. There is probably no technical reason to assume that these problems cannot be solved if they are approached objectively and with full understanding of what they imply, but the difficulties must not be underestimated. As a matter of fact, this problem of industrial radioactive wastes is only one of a number of continuing technological headaches which the rapid application of science has brought about in our society. Fortunately there are those within the industry as well as in our public bodies

who are aware of the seriousness of the problem of radioactive waste disposal, and it was for this reason that the hearings before the Special Subcommittee on Radiation were held in Washington during the early weeks of this year. This subcommittee invited the leading experts and minds in the country to contribute papers and discuss these problems with the members of the Committee. The testimony, discussion, and technical papers presented at these hearings form the content of the four volumes previously mentioned. If nothing else, the sheer volume of the data impresses one with the importance of the problem, but the technical content is extremely valuable and these volumes no doubt form the most comprehensive treatment of the problem of radioactive waste disposal that has been made anywhere.

The Total Environment. The nuclear industry is not unique in its production of industrial wastes. Virtually every important industry has been confronted with problems of waste disposal that affect the public interest to a greater or lesser degree. For many years questions of air and water pollution by industry have been problems of public bodies which have resulted in the formulation of various legislative measures for their control. The characteristic which distinguishes radioactive wastes from other industrial wastes, and which makes them more dangerous as they may be released to the air, the soil, or surface waterways, is that they are not detected by the human senses, and that their dangerous effects may persist over decades or even centuries. Thus, in the disposal of radioactive wastes, the total environment of man becomes the area of public interest. Since the creation of these wastes is related to the nature of the industrial processes, to the environment, and to the permanent maintenance of equilibrium conditions for the protection of biological life, every problem of plant location in relation to its environment must be considered. Once the industry comes into operation, the continued rigid supervision and monitoring cannot be relaxed.

The levels of activity of radioactive wastes from the various industrial processes involved in the nuclear industry are generally quite low until the fission reaction takes place in nuclear reactors. When the fuel is irradiated by neutrons in reactors, tremendous amounts of fission products are created; and when the fuel has been spent or depleted, these have to be removed and disposed of. The handling and disposal of these highly radioactive wastes requires extraordinary care and time, and the exposure of the workers is rigidly controlled. Highly active material is stored in designated areas or buried. Low-level wastes are stored in tanks or retaining basins until their activity has decreased to a value permitting them to be discharged into rivers and lakes or to the atmosphere where gases are involved.

Up to the present, the atomic industry, through the control exercised by the AEC, has kept the hazards in the disposal of its industrial radioactive wastes well below any appreciable effect upon the industrial worker or the population at large, but no generally acceptable plan has as yet evolved for the final disposition of the very large quantities of highly radioactive wastes that are anticipated in the future. No solution other than semi-permanent storage in artificial structures is available now for the containment of high-level wastes. The present practice of storing high-level waste in tanks is a temporary expedient inherited from wartime. It is temporary because, even if tank storage should ultimately turn out to be the most economical means for the management of wastes, the serviceable life expectancy of the tanks themselves may be only a fraction of the hazard-life of some of the fission products they contain.

Underground storage in tanks imposes other unusual problems, for example, the continuous production of heat in the waste liquids by the beta and gamma radiation resulting from the decay of radioactive isotopes. This form of heat generation is a unique industrial phenomenon since it is not controllable by any known method. In concentrated wastes the heat generated is sufficient to cause the wastes to boil for long periods of time due to the decay of the long-lived fission products (cesium and strontium). Indeed, operating conditions are possible which would create a waste that would boil for a hundred years. To some extent

such boiling is utilized to reduce the volume stored by letting the wastes concentrate themselves. The fact that the heat generation rate decreases as the radioactive isotopes decompose to stable elements is not a significant factor in design because the highest initial rates must be provided for.

Ocean? Not Big Enough. The disposal of high-level wastes in the ocean has had much discussion. Both in the United States and Great Britain, such wastes have been packaged in stainless steel containers encased in heavy concrete and sunk in the deep parts of the oceans. It is not logical, however, to conclude in view of present limitations of oceanographic knowledge that this practice will be sanctioned in the years to come. So many unknowns and unpredictables, with respect to oceanic behavior, still remain that management and governments will be driven to the safer practice of keeping high-level radioactive wastes under more obvious scrutiny and control than would be provided by most ocean disposal procedures. While it is hoped that the containers used in present ocean disposal procedures will remain intact for at least a century, there is no absolute assurance they will do so, and even then, that is, after a hundred years, a certain amount of activity will still prevail.

With respect to ocean disposal, a simple illustration will help to clarify the scope of the problem. The tolerance limit that is generally accepted for mixed radioisotopes in drinking water in the United States is 10^{-7} microcuries per milliliter, or 420 curies per cubic mile of water. At a waste-production rate of 100×10^9 curies per year by 1980, dilution of the waste produced in one year to acceptable limits would require 238 million cubic miles of water. The total volume of water in the oceans is 317 million cubic miles. This gives us a useful yardstick. The figure, 100×10^9 curies per year is probably quite meaningless to most of us. We can appreciate it better if we realize, that allowing for continual decay of radioactivity, enough radioactivity will be generated by 1980 so that the entire volume of the oceans would be needed to dilute the activity generated by about two years of power reactor operations.

Obviously, the major part of all radioactive waste that is generated will have to be contained in some manner. Tank storage of this material would probably be physically possible, but the danger of accidental release would be an ever-growing biological threat.

Storage in Geologic Environments. Among the various disposal methods considered, two seem to offer some promise at present: (1) storage in formations of natural salt; (2) storage in deep, permeable formations in which natural conditions would prevent the migration of the waste. It has also been suggested that wastes could be disposed of in the underground spaces left by depleted mines.

Much study has been given the possibility of utilizing such natural formations, and natural salt deposits seem to be promising. Salt is readily soluble in water, and salt deposits generally can exist at or near the land surface only in very dry climates. The occurrence of salt at depths is independent of present climates. Because salt deposits are dry, impervious, and do not fracture, radioactive wastes might be stored and contained indefinitely in them.

Salt is plastic (it flows under pressure) so it is self-sealing, that is, it contains no free openings at depth because they are sealed by plastic formation. Because of these favorable properties, salt has been studied more than any other geologic material as an environment for waste disposal. Salt, furthermore, is widely distributed in the United States, and deposits occur in at least 23 of the 49 states. If disposal in salt beds proves feasible, it may therefore be possible to locate disposal sites near power reactors and chemical processing plants. This would reduce the tremendous problems involved in the transportation of the radioactive wastes from the power plants to the disposal sites.

More than 24 million tons of salt is produced annually in the United States, but our reserve of salt is so stupendously large that it is essentially inexhaustible. Therefore, the use of carefully chosen salt deposits for disposal sites would probably not deny to us the salt that will be needed in the future.

Storage of liquid in salt beds is not a new or untried idea. In the last six years mining and oil field operations have created more than 28 million barrels of storage capacity for petroleum products, chiefly in salt deposits.

Mined space in such rocks as shale and chalk costs about $3.00 to $7.00 per barrel of capacity to create. Space in salt is formed much more cheaply—$1.00 to $2.00 per barrel of capacity, because it can be created simply by dissolving the salt with water. In contrast, above-ground storage of waste in steel tanks costs on the order of $20.00 per barrel of capacity.

Of course, even if storage in natural salt deposits proves feasible, many formidable problems remain. Methods for the injection of the liquid wastes into deep, permeable formations will have to be worked out. Loss of permeability in the ground due to chemical reaction between the earth materials and the injected liquid, corrosion of well casing by waste liquid, rate of heat dissipation, and chances for boiling and geyser action in injection wells, all introduce difficult problems involving both equipment and methods. The effectiveness of the geologic environment as a trap to contain the waste liquids for hundreds of thousands of years is also a factor about which little is known at present.

Utilizing Radioactive Wastes. Some people believe that the problem of high-level radioactive wastes may be solved by salvaging fission-product isotopes for beneficial use in industry and agriculture, in biological studies, and in medical services. To a certain extent this is possible. Many isotopes could be salvaged, but not all of the long-lived ones are useable now, and none are economically recoverable. For example, cesium and the rare earths may be separated and recovered, but this would not eliminate the need for storage of the residual waste for at least years or decades. Their removal would lower the radioactivity by a factor of 10,000 to 1,000,000, but the activity in the residual liquid would still be 1000 to 100,000 times greater than could be released to the environment.

Considerable work has been done in efforts to store the radioactive wastes in solids such as ceramic materials and in glass. In this form they would have great permanence and even if buried in the ground, there would be little danger of them being leached away. It has even been suggested that very high-level fission products stored in the form of glass and suitably shielded might serve as sources of low-level heat for space heating.

No doubt, certain quantities of radioactive fission products can find application in pharmaceutical plants and in food-processing establishments for sterilization of products, but it is unlikely that this market would be appreciable. In this area, high voltage accelerators will provide serious competition.

No student of this field can escape the fact that waste handling and disposal has international as well as national aspects. This is peculiarly an area where political boundaries have little or no relation to the waste disposal problem. This is particularly true in the dispersal of materials to the environment via the atmosphere and surface waters. From both the national and international standpoint, one cannot ignore the increasing problem which will result from the rapidly increasing use of mobile reactors, such as submarines, surface ships, and possibly aircraft in the near future.

From even this brief consideration of the subject, it will be evident that this question of radioactive waste disposal has presented the human race with a first-class headache which will take a vast amount of intellectual aspirin to dispel. The Curies could hardly have foreseen the stupendous problems their discovery of radium would someday impose on society. In the final analysis, it may be easier to lick the controlled thermonuclear reaction than to solve the waste disposal problem. A controlled thermonuclear reaction produces no lingering radioactivity.

Andrew W. Kramer

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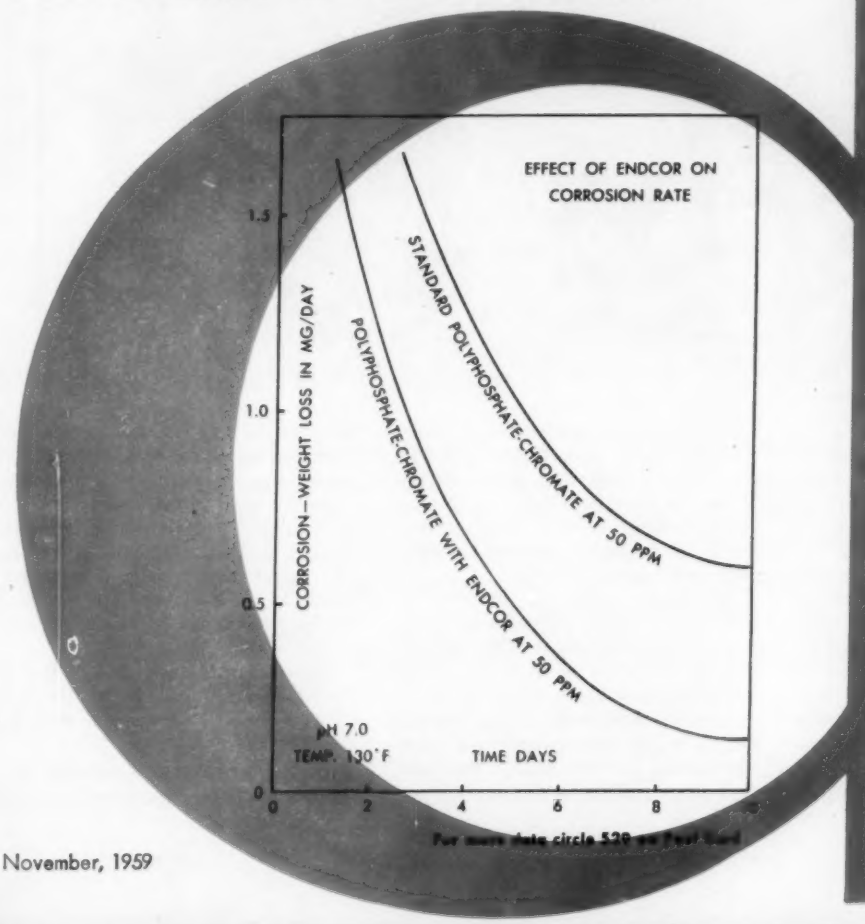

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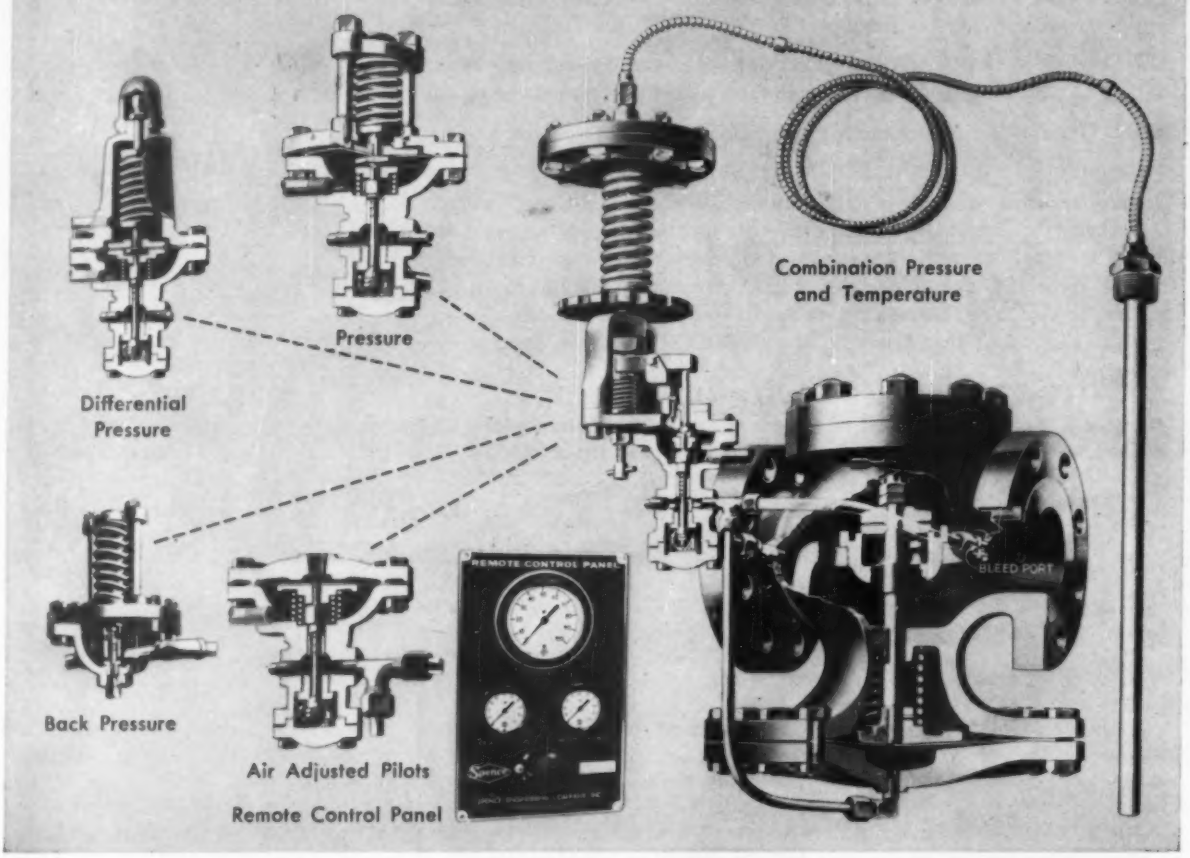
All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

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Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

SPENCE ENGINEERING COMPANY, INC.
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"Buffalo" Type "CR" Radial Wheel Fan

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The "CR" combines sharply rising pressure and horsepower characteristics with high static efficiency. Ruggedly-built, it gives long, trouble-free performance under severe conditions. The high pressure and capacity of this fan often permit use of a smaller unit for many direct-connected applications. This results in further first cost savings.

For dependable, stable radial wheel fan performance, investigate the "Buffalo" Type "CR" Fan. It's designed for both constant volume or inlet-dampered operation. Write for full information in Bulletin FD-205.

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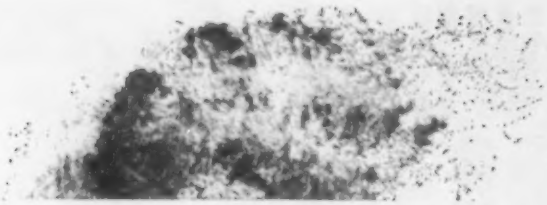

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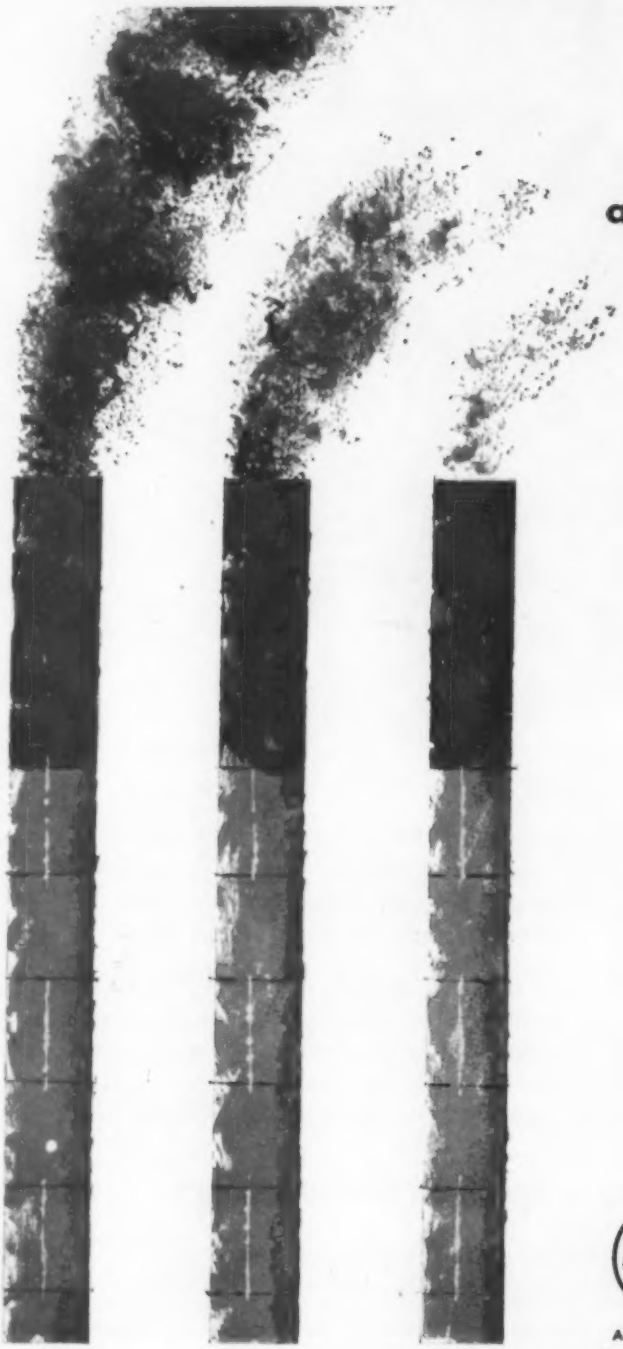

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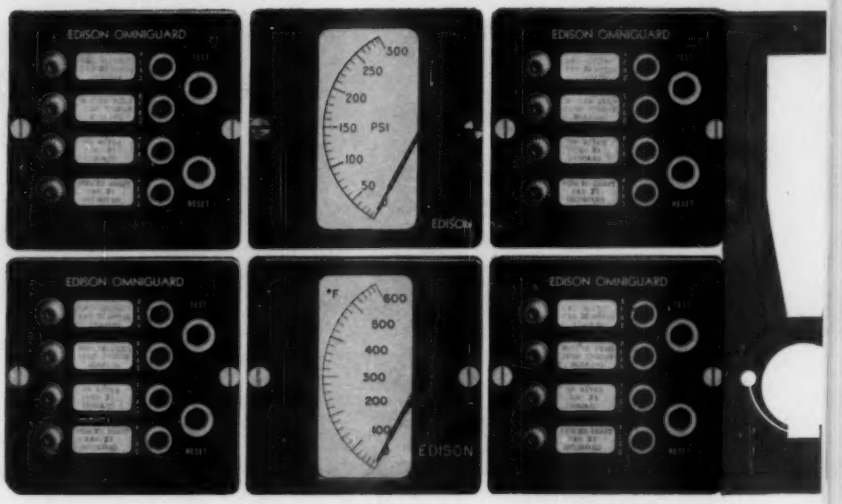
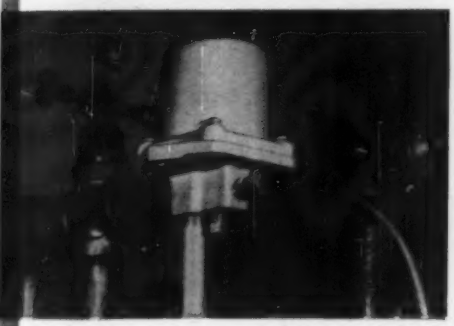
GUARD ALL CRITICAL PRESSURES AND TEMPERATURES WITH THOMAS A. EDISON LOW-COST, OMNIGUARD WARNING SYSTEM



Here is a versatile, highly-reliable continuous warning and monitoring system. By simply pushing a button on this panel you obtain a reading of *key pressure* and *temperature* points throughout your plant. In addition, this system provides instantaneous warning when pressure or temperature deviates from pre-set limits.

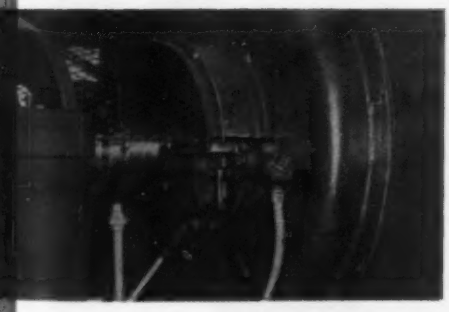


PRESSURE

With the Edison Omniguard system you can monitor gas, fluid or vapor pressure. Heart of the system is a rugged, accurate, pressure detector which converts pressure directly to electrical resistance—requires no millivolt conversion—no amplifier. For pressures under 60 PSI a precision capsule is the sensing element. From 60 to 3000 PSI special bourdon tube elements are used.

When pressure changes, resistance varies and this deviation is transmitted to the control panel. Units operate over ambient temperatures of 32° to 150°F. Control panels are available with a wide variety of scales and are equipped with both normally open and normally closed alarm contacts to operate any type of auxiliary device or to automatically shut down machinery or process.

Compact, reliable Resistance Pressure Detector transmits changes in pressure to central control panel.



TEMPERATURE

Edison Omniguard also provides reliable protection from overheating. You can monitor the temperature of bearings, gases and liquids in critical equipments or processes. Reliable Edison Resistance Temperature Detectors have no moving parts and give instantaneous warning when limits are exceeded. Unlike other systems which only scan, Omniguard is continuously monitoring. You can obtain exact readings of temperatures in all parts of your plant from one central control panel.

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Rugged, accurate Resistance Temperature Detector guards against overheating of this motor bearing.

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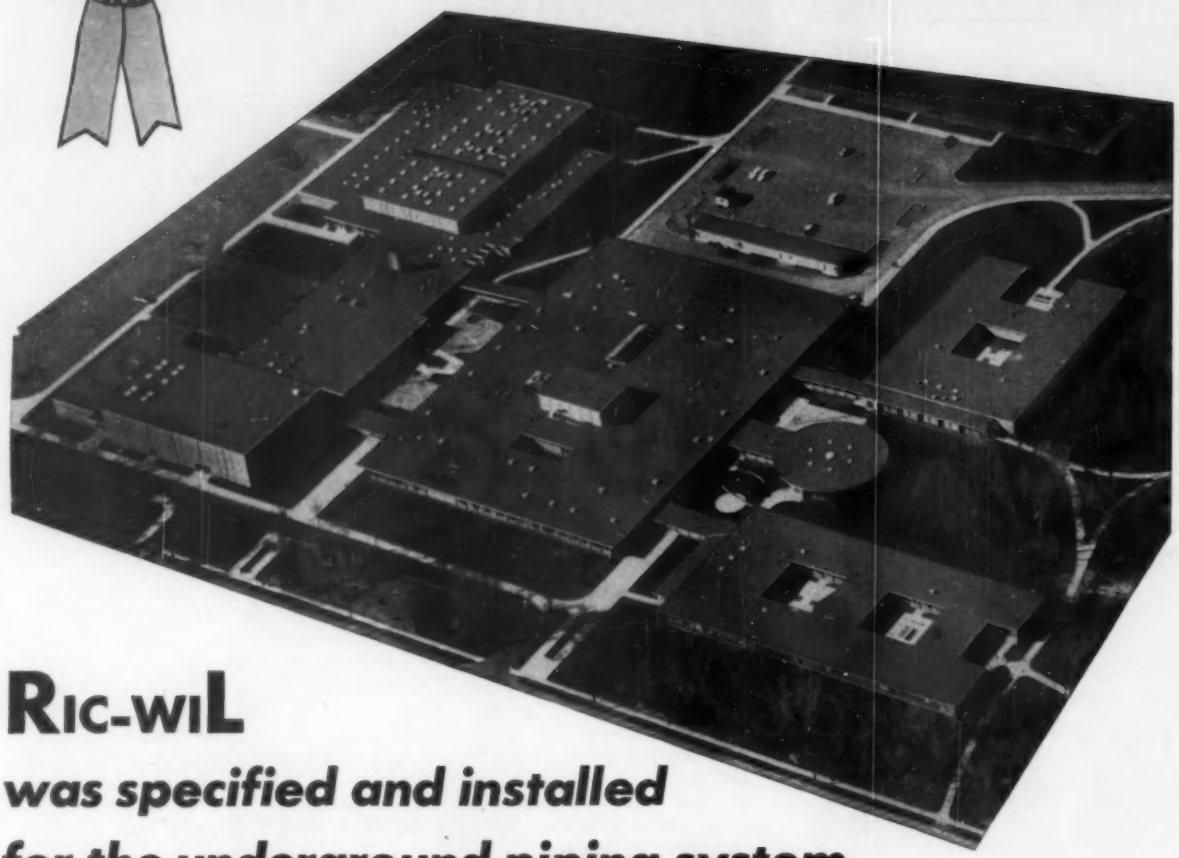

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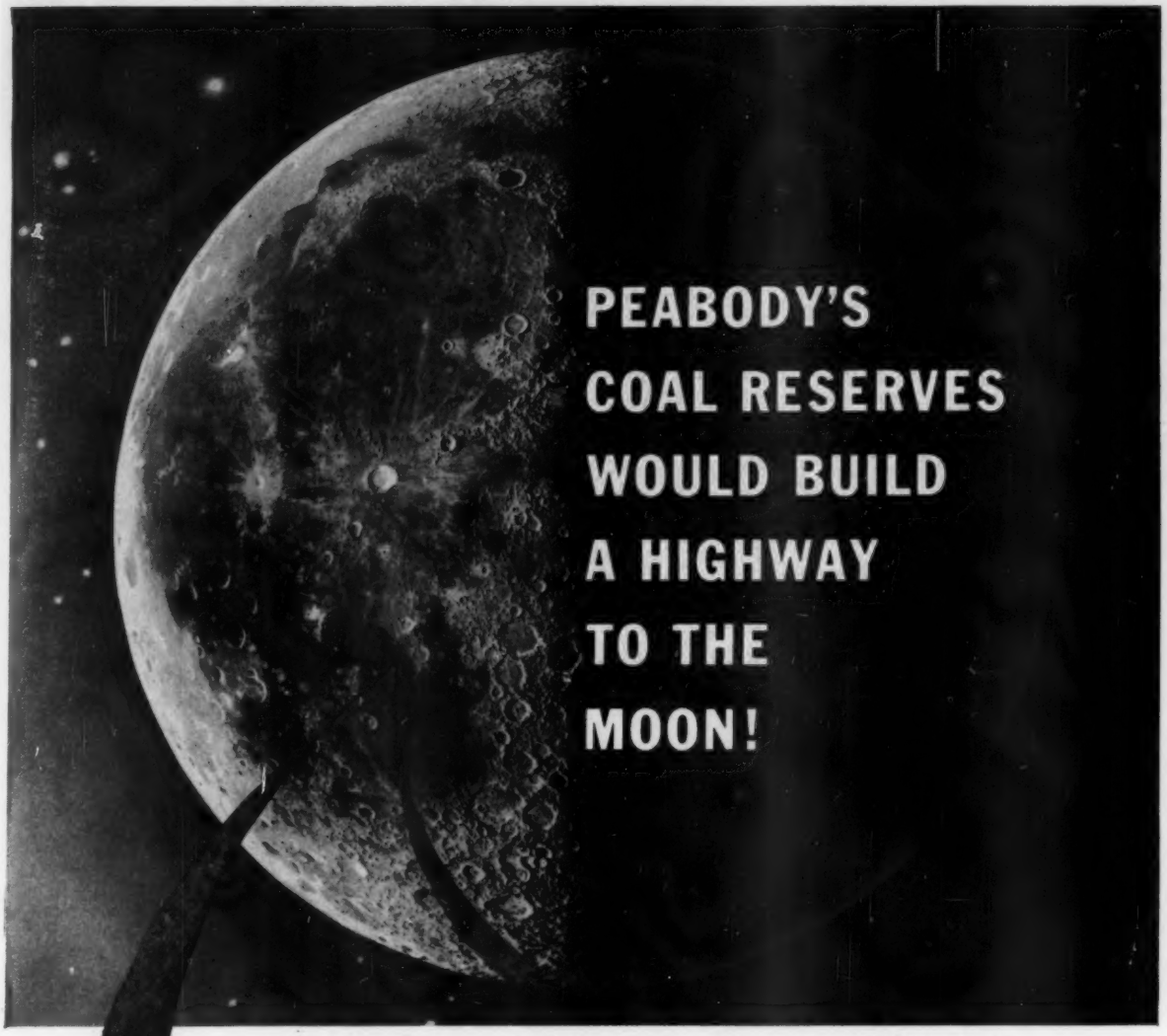

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HAGAN NEWSLETTER
Behind the Panel

ANOTHER STEEL INDUSTRY FIRST FOR HAGAN

A large eastern mill has ordered what is believed to be the industry's first solid state combustion control system. Hagan PowrMag (magnetic amplifier) systems will be installed on a two-zone slab heating furnace, and will include zone temperature, zone fuel-air ratio, furnace pressure, recuperator temperature balance, and air pressure controls. Recording instruments (Hagan PowrLog) and panels will also be Hagan. Using PowrLog electronic recorders and PowrMag controllers, the system for each zone provides parallel operation of the combustion air damper and fuel oil control valve from the zone temperature controller. Fuel and air are measured and a fuel-air ratio correction is applied to the combustion air damper. The combustion air flow measurement is automatically compensated for temperature variations. Gas firing is contemplated for the future. (Item L-1)

GAS CONTRACT PENALTIES AVOIDED WITH RING BALANCE METERING

The increasing use of gas in the steel industry has brought about the necessity for central gas dispatching stations. By accurate control of gas usage, large users can avoid the penalties incurred when gas contracts are exceeded, and at the same time, make maximum use of available coke oven gas. Hagan Ring Balance meters have been chosen for this critical application by a large mid-western steel mill for a number of reasons, the most important being the inherent accuracy of the Ring Balance Principle. This basic accuracy is reinforced by the ability of the Ring Balance to compensate precisely for fluctuations in pressure and temperature, and the ease with which it can be calibrated. Add rugged construction, accurate electrical remote transmission and the ease with which range can be changed on a 7 to 1 basis, and the Ring Balance becomes the meter of choice for such applications. (Item L-2)

THESE SYSTEMS HAD TO BE EASY TO INSTALL

Easy to install—easy to calibrate—are commonly used phrases in the control business. But one Central American plant is willing to testify that this is strictly true—as far as Hagan systems are concerned. Combustion control, drum level control, meters and control panels were purchased from Hagan for a new 110,000 lb/hr boiler for a Central American steam electric station. Using Hagan instruction books and drawings, the entire system was installed, calibrated and put on the line without a single hitch, and a Hagan engineer has never been at the plant. All the systems have been functioning "beyond expectations" and maintenance has been minimum. (Item L-3)

HOW TO MEASURE A SMELL

To further decrease the risks of handling natural gas, an odorant is frequently added when the gas is transferred from underground storage areas back into the distribution system. The amount of odorant added is extremely critical, since too much makes the smell extremely objectionable, while too little makes the detection of gas leaks difficult. For this service, a pressure compensated Ring Balance meter, together with a Hagan ratio relay, controls a proportioning chemical feed pump. Installations of this accurate team are in service at a major gas supplier in the mid-west. Odorization of the gas is extremely accurate, and the installations have more than met the stringent specifications. (Item L-4)

HAGAN CONTROLS DO "SUBMARINE" SERVICE ON SURFACE VESSEL

One of our largest surface ships is equipped with Hagan controls, including combustion, feed water and boiler feed pump systems. On a recent cruise, a defective main condenser valve allowed a main machinery space containing the Hagan combustion and feed pump controls to be flooded. The control systems were under water for a total of 36 hours. Crew members cleaned up the equipment, and when the carrier docked, Hagan service representatives were requested to check out the control systems. The controls were found to be in first class condition, needing only two minor needle valve adjustments. Hagan marine systems are not only extremely accurate, providing the most economical operation, but they are built to "take it." (Item L-5)

HAGAN CHEMICALS & CONTROLS, INC.

Hagan Building, Room 710, Pittsburgh 30, Pennsylvania
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy
If you would like more information on any of the above items, check the appropriate box below.

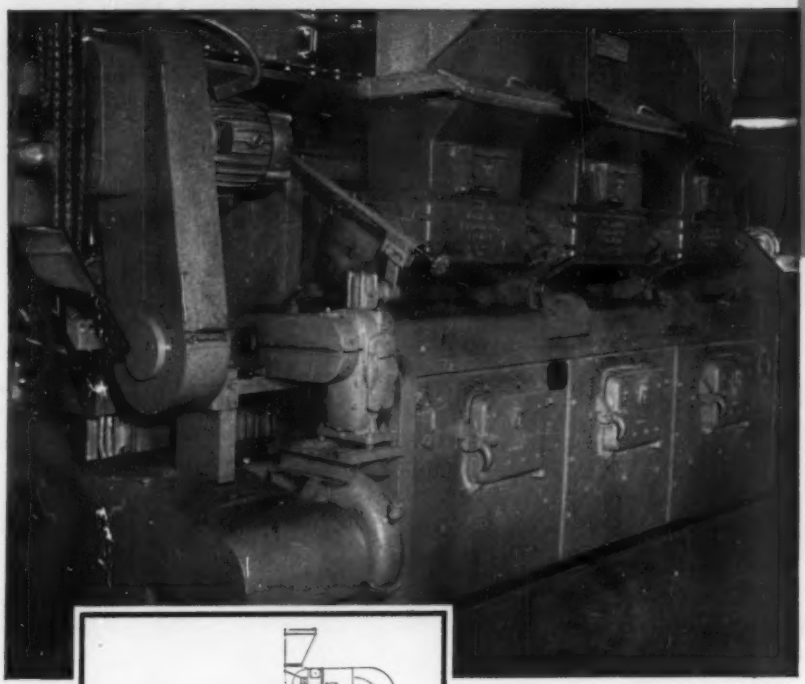
☐ Item L-1 ☐ Item L-2 ☐ Item L-3 ☐ Item L-4 ☐ Item L-5

For more data circle 536 on Post Card

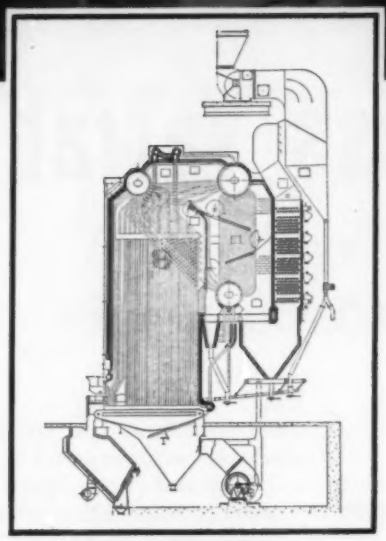
Availability?...

HERE'S A RECORD TO SHOOT AT..... *Only*

5 HOURS OUTAGE in 5 years



A Detroit RotoGrate Stoker



AT OTSEGO

Detroit RotoGrate Stoker with Wickes Boiler; 650 pounds pressure, 750°F temperature. Cummins & Barnard, Consulting Engineers.

This record of only 5 hours outage in over 5 years is reported by Otsego Falls Paper Mills, Otsego, Michigan, a division of Menasha Wooden Ware Corporation.

Walter Boettcher, Chief Power Engineer says: *"5 hours in 5 years and 4 months is the record of down time due to the RotoGrate Stoker outage"* in this well operated single boiler plant.

"It operates 24 hours a day—5 to 6 days a week, 60,000 to 90,000 pounds of steam per hour.

"Paper mill load fluctuations handled easily without pressure loss."

This record indicates a fine job of equipment maintenance, but high availability can be taken for granted with the DETROIT ROTOGRATE.

A customer survey taken in all kinds of plants proves it.

DETROIT ROTOGRATE COSTS LESS

Cost = initial investment + upkeep + production losses due to outage of equipment. The total is less with RotoGrate.

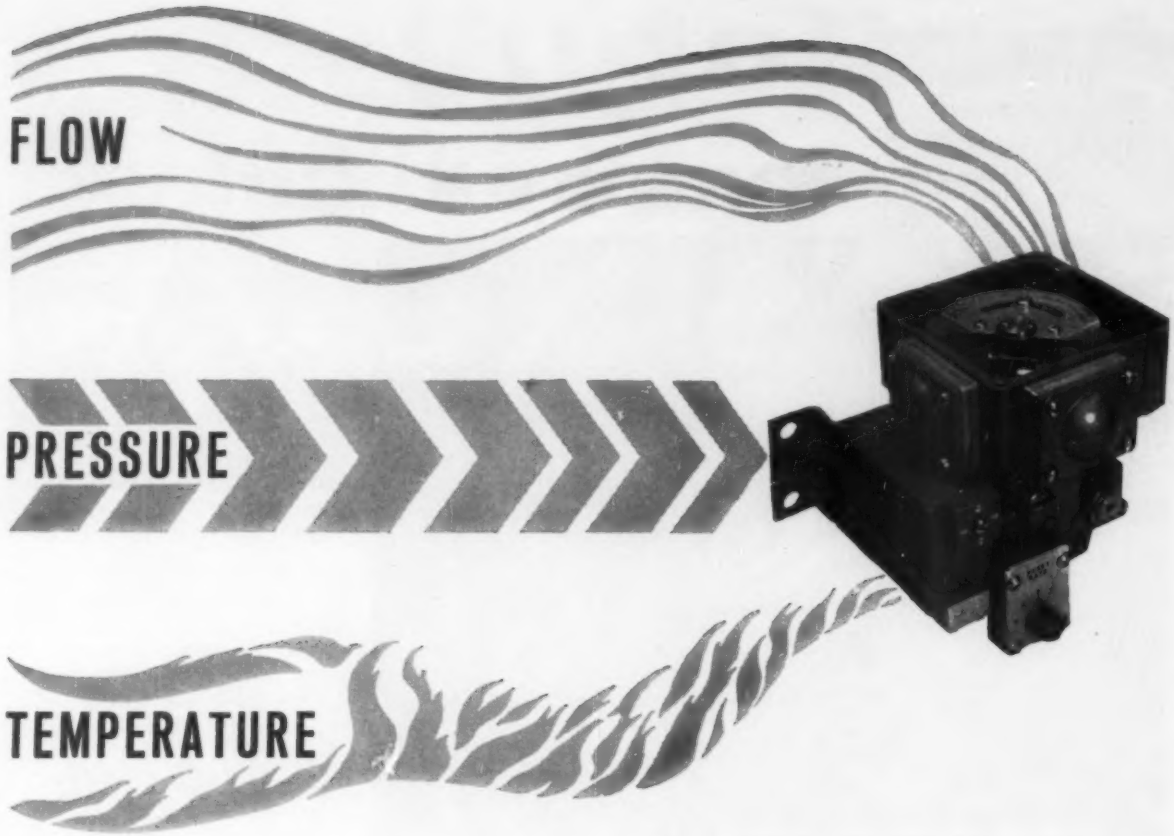
DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

For more data circle 537 on Post Card



Control Any Process Variable

with a system based on

REPUBLIC'S NEW TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts*, for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action. Local or remote pneumatic set point optional.

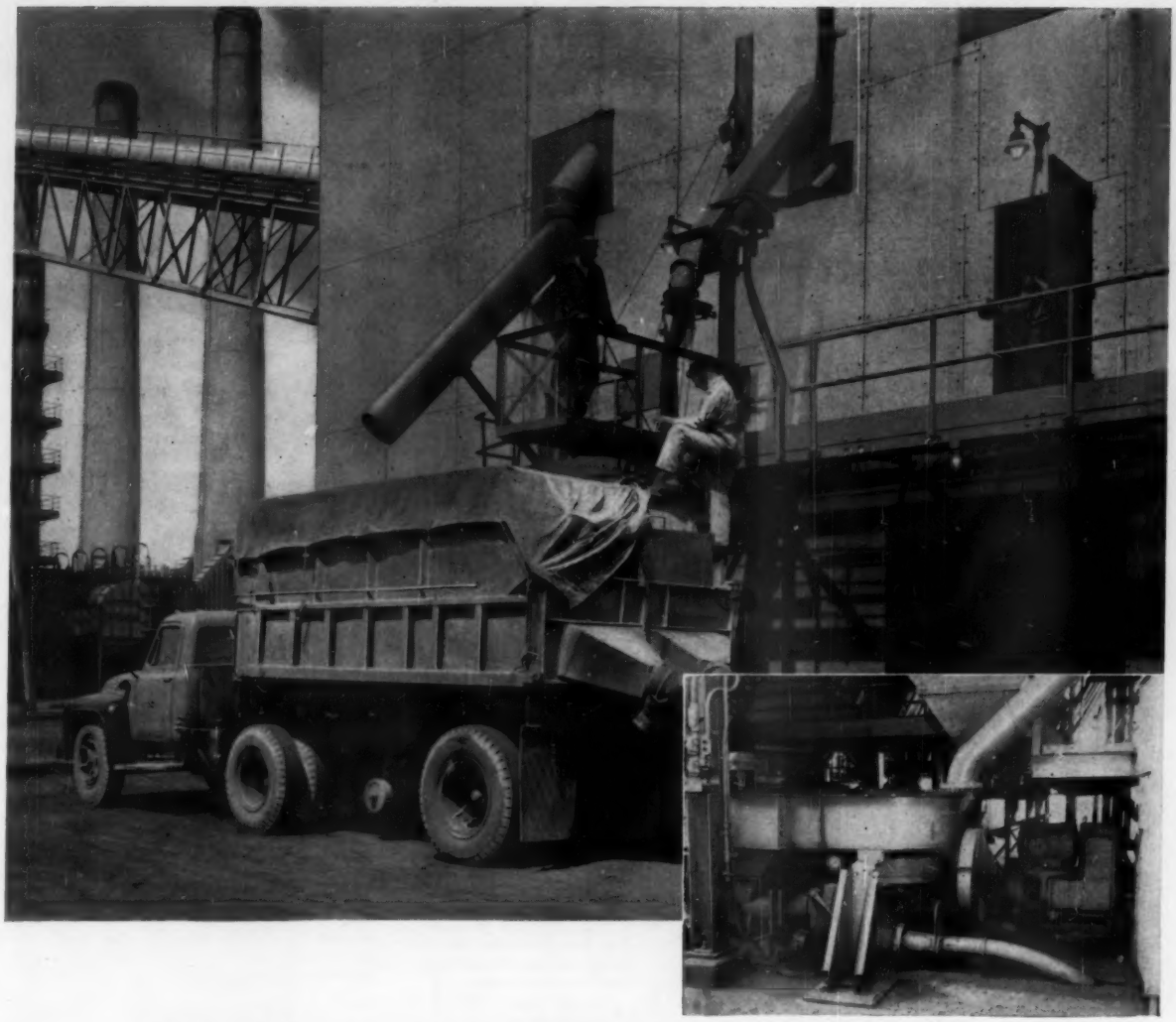
Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Republic Sales Offices are located in principal cities throughout the U.S.A. and Canada.

REPUBLIC
FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

For more data circle 538 on Post Card



Public Service Electric and Gas Co. Turns Fly Ash Problems Into Profit

By using Fuller pneumatic conveying systems, the Sewaren Generating Station of Public Service Electric and Gas Company, New Jersey, was able to collect 4100 tons of fly ash during 1957. Not only did this eliminate a serious disposal problem that formerly contributed heavily to operating costs . . . it also gave the utility which sold the collected fly ash, a new and valuable source of income.

The Fuller-Kinyon system at Sewaren collects and carries the fly ash to two storage silos that have a combined capacity of 380 tons. It is then either bagged in 50-lb. lots or transferred in bulk through a Fuller loading-out silo spout to tank trucks or covered dump trucks. Labor and equipment costs are kept at a minimum. Dusting is avoided, and high tonnages are handled easily over considerable distances. Extra handling flexibility is provided by a Fuller two-way diverting valve that permits unsuitable fly ash to be pumped directly to an ash reject tank instead of to storage.

Fuller pneumatic conveying systems can be installed almost anywhere at minimum costs, regardless of plant conditions. Moisture and dirt cannot enter the system and material cannot escape. Write today for detailed information in Bulletin FF-49-1. 1334 G-202

Fuller
pioneers in harnessing AIR

FULLER COMPANY
150 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

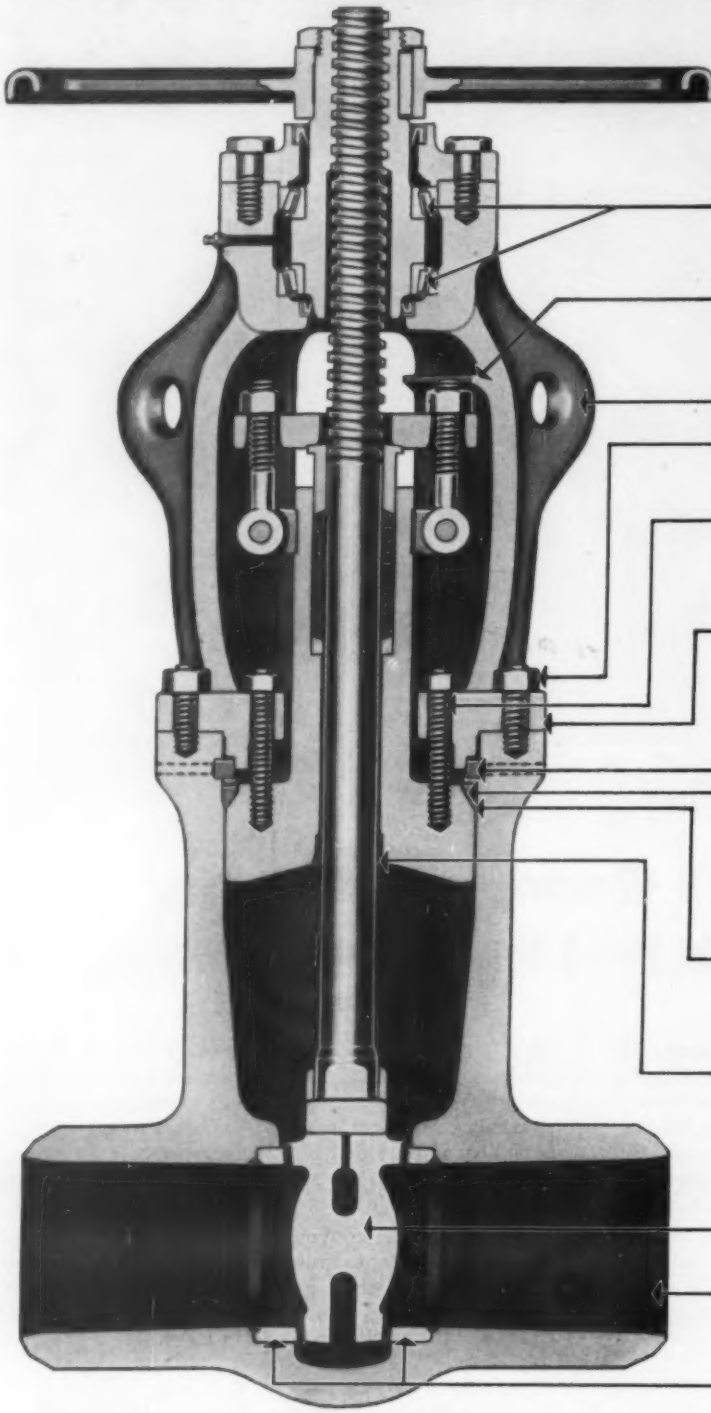
FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more data circle 539 on Post Card

POWELL PRESSURE SEAL VALVES

GATE, GLOBE, ANGLE and CHECK PATTERNS

Pressure Classes . . . 600, 900, 1500, 2500 Pounds and Higher . . . ALL COMMERCIAL SIZES



Tapered roller bearings are most satisfactory for high thrust loads.

Lugs on the inner side of yokearms provide a convenient shelf for suspending gland flange when renewing packing.

Lifting lugs facilitate handling the valve during erection and maintenance. Also provide means for supporting weight of the valve.

Body studs hold the yokearm to the body. These eliminate the need of a heavy clamp, and maintain perfect alignment and rigidity of yoke to the body.

Bonnet studs are used to establish the initial seal of the gasket between the body and the bonnet.

Streamline contour of body simplifies application and reduces cost of insulation, and effects marked savings in space and weight.

Segmental thrust ring absorbs all the thrust applied by internal pressure. This design enables valve to be easily assembled and disassembled.

The gasket may be removed without damage to seating surface of body.

The gasket seating surface in the body may be easily lapped, if required—an outstanding feature in Powell Pressure Seal Valve design.

Stellite faced back seat and stem guide insure tight sealing, accurate guiding of stem and protects packing when valve is back seated.

Flexible "H"-type wedge, which is stellited, prevents sticking because of temperature changes and pipe line stresses, thus reducing opening torque.

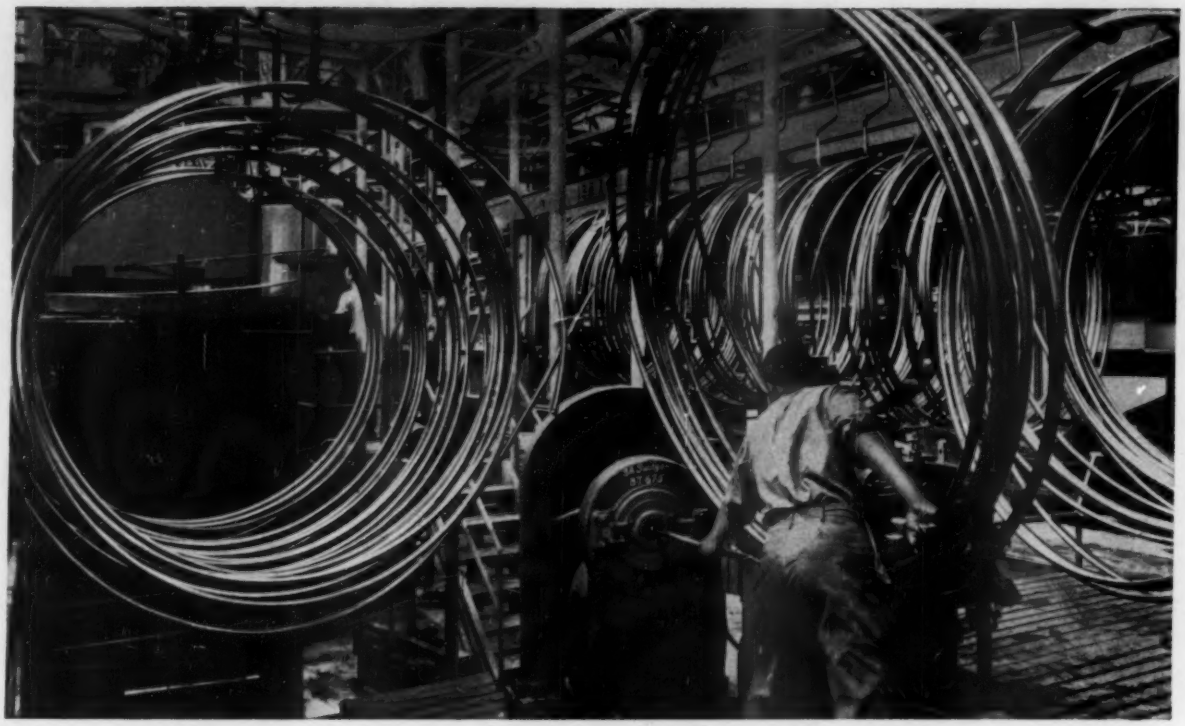
Streamlined passage makes possible maximum flow with minimum turbulence.

Seat Rings are stellite faced, accurately machined and welded in place.

(Sectional) PRESSURE SEAL GATE VALVE

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

For more data circle 544 on Post Card



things you should know about

WOLVERINE TUBE

You know what they say—about change being the father of progress.

Well, that's the way it is at Wolverine Tube and we'd like to tell you about some of the new things going on at Wolverine.

For example, Wolverine recently completed a multi-million dollar modernization program at its Detroit, Michigan plant. New machinery and new tube-making techniques have made this plant one of the most modern in North America. Wolverine also operates large, modern plants in Decatur, Alabama and London, Canada.

There are new things afoot metalwise at Wolverine, too. In addition to copper and aluminum, Wolverine Tube now works in such metals as Columbium, Molybdenum, Tantalum, Titanium, Vanadium and Zirconium, etc. It's the result of an extensive research program started many years ago, and it gives Wolverine customers a big edge when they require an experienced tubing and fabrication source for these "metals of tomorrow."

Also, to insure top-flight sales service, Wolverine has expanded its nation-wide sales staff to include a number of highly trained Technical Sales Representatives. These men are specialists in all phases of tubing selection and application, particularly in the field of heat transfer. Their services are available at all times . . . you have only to ask.

So . . . if your company is looking for the finest of tubing and the finest of service, you'll find both at Wolverine Tube where improvement is a continuing program.

CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION

In Canada:
CALUMET & HECLA OF CANADA LIMITED
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO. LTD.
UNIFIN TUBE DIVISION

WOLVERINE TUBE
DIVISION OF
CALUMET & HECLA, INC.
17266 Southfield Road
Allen Park, Michigan
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
SALES OFFICES IN PRINCIPAL CITIES

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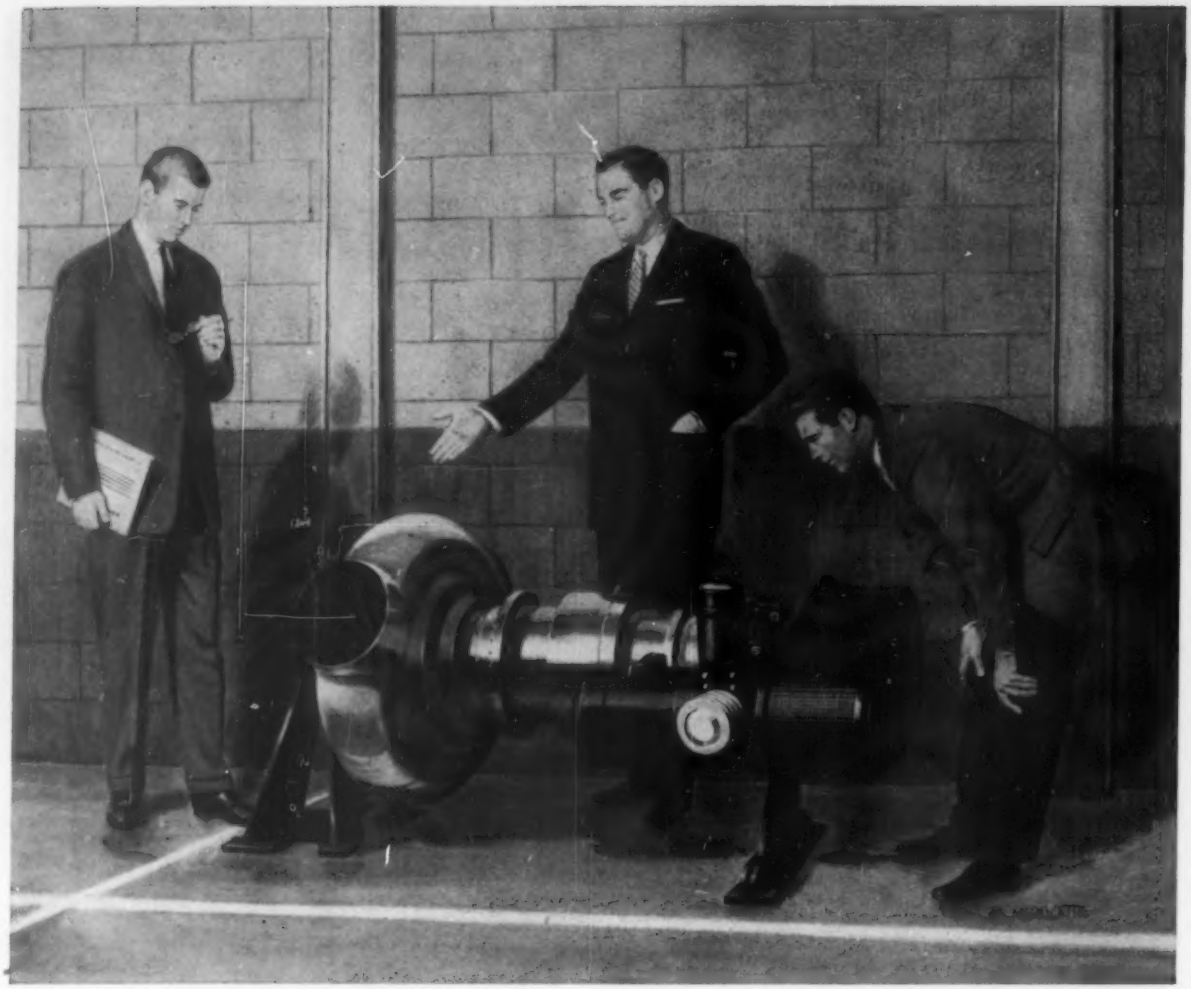


1100 HP!

New Solar gas turbine offers small size, light weight, greater fuel efficiency

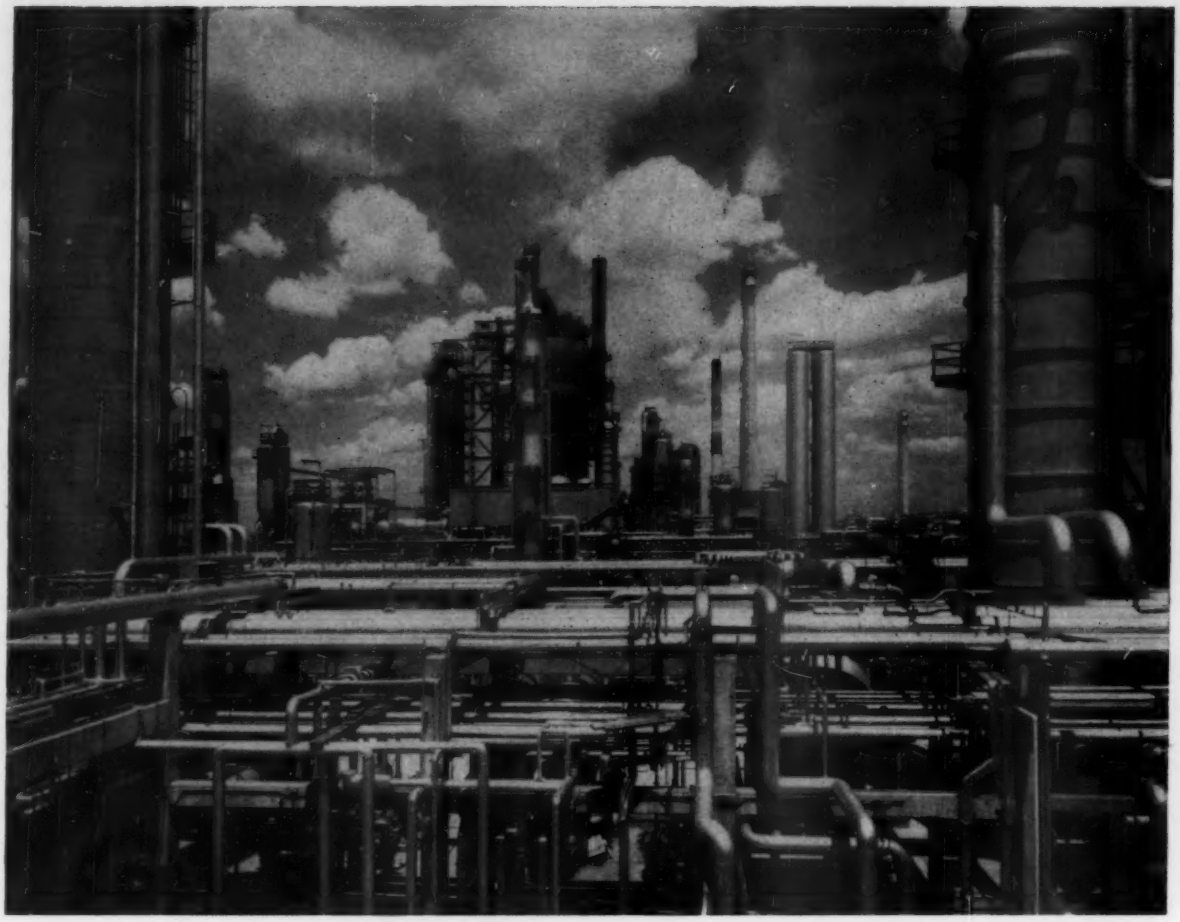
SOLAR'S REMARKABLE NEW 1100 hp *Saturn* gas turbine represents an important forward step in gas turbine fuel efficiency—requiring only .63 pounds of fuel per hp hour. The engine is extremely lightweight, averaging less than 1/10th the weight of conventional engines of similar hp; it occupies only about 51 cubic feet; it starts instantly and takes full load without laboring in temperatures from −65F to 130F, even after long periods of standby service. And the new Solar *Saturn* engine will operate on a wide variety of fuels.

Today, proven-in-service Solar gas turbines—ranging from 50 to 1100 hp—are creating new standards of performance and reliability. As propulsion units for boats, as a dependable power source for electric generators, as high-efficiency pumps and in other applications... Solar gas turbines are saving time and money for hundreds of satisfied users. For a new gas turbine brochure, write to Dept. G-151, Solar Aircraft Company, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY

ENGINEERS WANTED! *Challenging projects, unlimited opportunities with Solar. Write today!*

For more data circle 542 on Post Card



CALGON CORROSION CONTROL PROTECTS THESE VITAL AREAS

Piping, heat exchangers, condensers . . . these are the vital areas where corrosion and other water damage in cooling systems can result in unscheduled downtime, or even force shutdown of the whole process. Costly equipment may be damaged, and production brought to a halt. The losses that can result far outweigh the modest cost of adequate protection.

Call on Calgon Engineering Service to insure protection of the entire system. From cooling towers on through, the Calgon engineer can save you money and time. Experience with every type of water problem in all parts of the country, backed by complete laboratory facilities, is at your service.

Corrosion control with Calgon* is only one of the many services available. A letter or phone call will put a Calgon engineer to work on the solution to your particular water problem.

*Calgon is the Registered Trademark of Calgon Company for its sodium phosphate glass (sodium hexametaphosphate) products. Licensed for use under U. S. Patent 2,337,856.

CALGON COMPANY
DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

For more data circle 543 on Post Card

Still ANOTHER Cottrell Advancement By Western Precipitation...

UNIQUE "FULL-RANGE" RAPPER CONTROL PROVIDES ENTIRELY NEW STANDARDS OF VERSATILITY

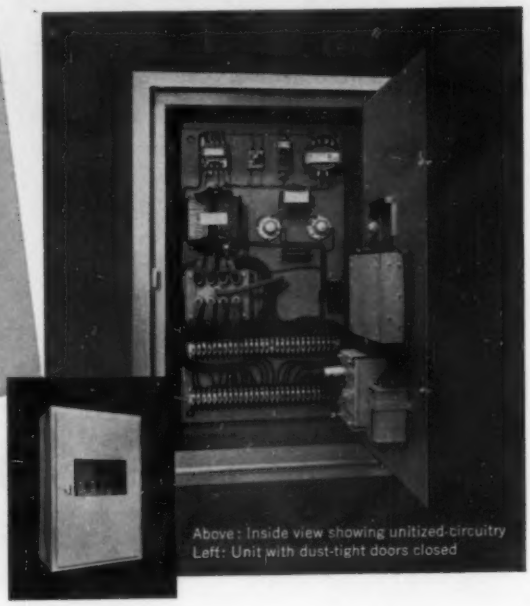
Rapping Frequency...Rapping Intensity...Rapping Pattern
ALL EASILY ADJUSTABLE TO MEET OPERATING REQUIREMENTS

THE PROBLEM:

In the operation of Cottrell Precipitators it is necessary to remove the dust, fume or fly ash that has collected on the plates and cause it to be deposited in a hopper for subsequent removal from the Precipitator. The Rapping System should accomplish this removal with minimum disturbance to the already collected material (to avoid re-entrainment) and with maximum cleaning of the plates.

However, collected materials vary widely in their physical characteristics. Some are sticky. Some agglomerate readily and in thick layers without disrupting electrical operation. Still others have no tendency whatever to agglomerate, but form a sheet of loose particles on the plate.

There is no "typical" dust—no fixed set of conditions to be met. Yet the Rapper System must be readily adaptable to efficient dust removal, regardless of dust characteristics!



Above: Inside view showing unitized-circuitry
Left: Unit with dust-tight doors closed

THE SOLUTION:

With so many variables to be compensated, unusually wide adjustability of the Rapper System has long been a prime objective for optimum operating efficiency. But complex factors have prevented its attainment until development of Western Precipitation's new "Full Range" Rapper Control.

By simply adjusting a few dials, "Full Range" Control permits:

- **FULL FREQUENCY ADJUSTMENT**
  from a complete rapping cycle every 50 seconds to one every 3½ hours...or any desired cycle in between!
- **FULL INTENSITY ADJUSTMENT**
  from zero to maximum over an unusually wide range!
- **FULL PATTERN ADJUSTMENT**
  2, 4 or 8 impacts per cycle can be selected, with each cycle varying from light to heavy on successive impacts within the cycle—all automatically controlled to a choice of pre-selected operating limits!

Other Important Advantages...

Greater Safety: The "Full Range" Control has no dangerous high voltage circuits to endanger personnel. Entire unit is in "low-voltage" category.

All "Passive" Design: There are no motors, gears, or other high maintenance components in the "Full Range" Control. It is completely electronic.

Space-Saving Compactness: The "Full Range" Control requires about *half* the space of previous designs. Also is water and dust tight—can be located virtually anywhere.

Unitized Circuitry: All related parts are unitized into separate "cans" for simplified maintenance.

Free! **NEW BROCHURE**
which describes and illustrates the new "Full Range" Rapper Control—the latest product of Western Precipitation's program of continuous advancement!

For quick assistance, call or wire **collect** *our nearest office.*

A-M-101

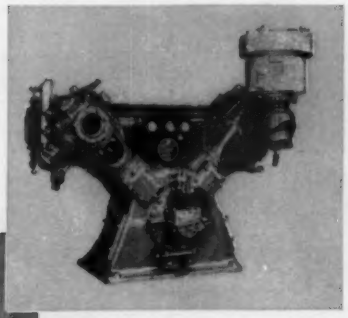
COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
THERM-O-FLEX Hi-Temp Filters
TURBULAIRE-DOYLE Scrubbers
HOLO-FLITE Processors
HI-TURBIANT Heaters

WESTERN
PRECIPITATION
CORPORATION

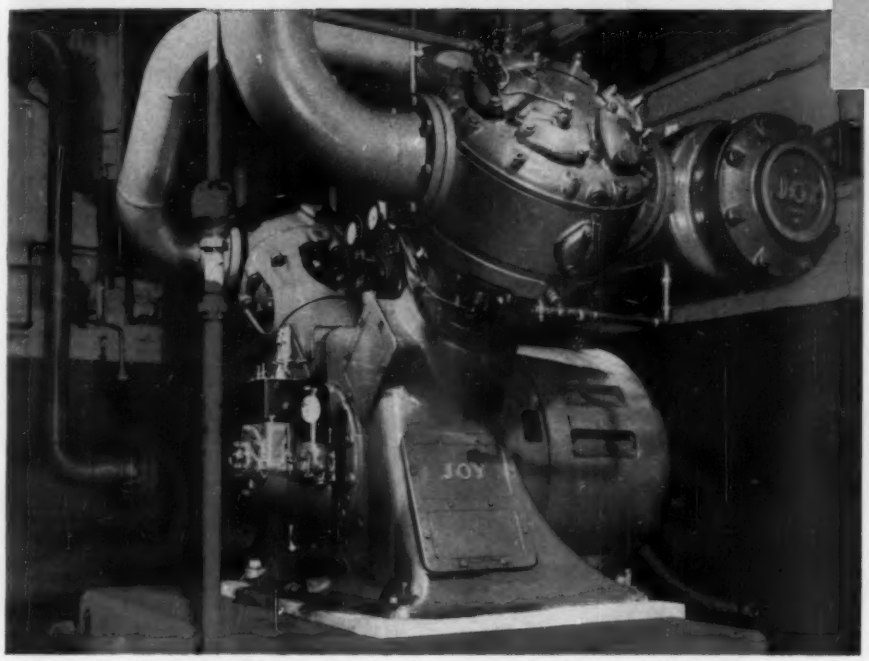
Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

LOS ANGELES 54 • NEW YORK 17 • CHICAGO 2 • PITTSBURGH 22 • ATLANTA 5 • SAN FRANCISCO 4
Representatives in all principal cities
Precipitation Company of Canada Ltd., 8285 Mountain Sights Avenue, Montreal 9

For more data circle 540 on Post Card



Compact design means simple installation. Set up on a simple block foundation, bolt down and connect air and water lines.



the COMPACT compressor with big compressor features... Joy WN-112

Only the package designed WN-112 has such heavy-duty features as replaceable cylinder liners and crosshead guides. These liners are made of special alloys which make possible fine machining and mirror-like polishing. The crosshead has no wedges, set screws or shims—never requires adjustment. The main bearings never need adjustment either because they are anti-friction, heavy duty ball, or spherical roller type. These, and other big compressor features add up to trouble-free performance that has made friends of literally thousands of plant and power engineers throughout industry.

When you are expanding your operations and require more compressed air, make sure you have details and complete information on the WN-112, one of a complete line of compressors for industry. You can then select any one of 24 standard models of the WN-112 plus special models for high and low pressures as well as oil-free operation. Capacities from 480 to 1072 cfm. Write for bulletin 340-56C.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

For more data circle 545 on Post Card

Less than ¼ turn opens or closes

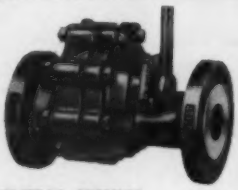
When you need...

- Quick action
- Leak-Proof Seal
- Minimum Pressure Drop
- Straight-through full flow
- Valves that cannot wedge or jam
- Self-grinding rotating disc

Specify Everlasting Valves

For more information WRITE for these bulletins.

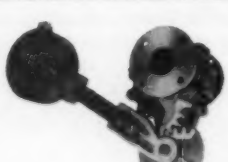
BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



GENERAL SERVICE
Where drop-tight seal and full flow is essential.

CYLINDER OPERATED
Can be remotely controlled, electrically or manually.

STEAM JACKETED
Assures free flow of viscous materials.



WEIGHT-OPERATED
For automatic drains or emergency shut off.

Everlasting VALVES

EVERLASTING VALVE CO., 47 FISK STREET, JERSEY CITY 5, N. J.

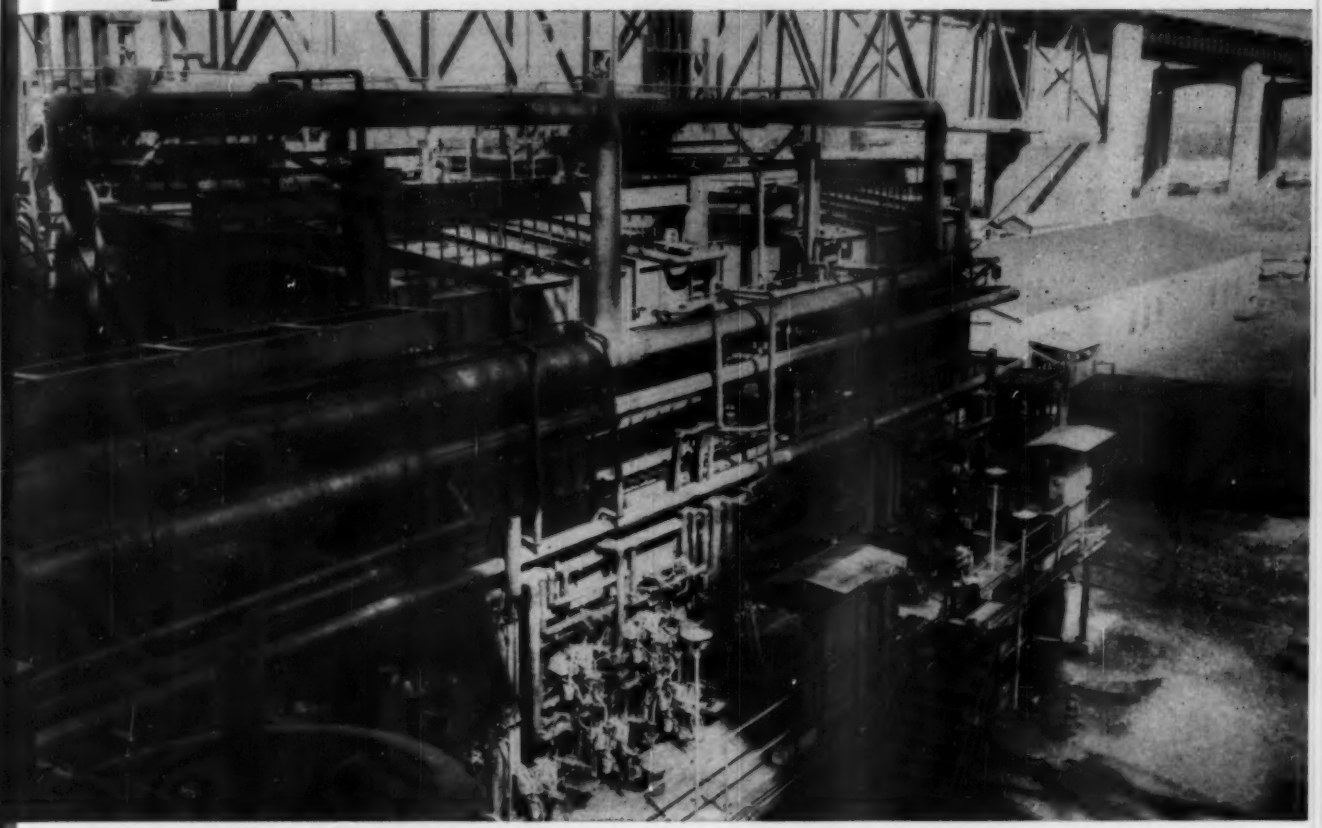
EV 404

For more data circle 546 on Post Card

COPES VULCAN

BLAW-KNOX

How Copes-Vulcan control systems boost power plant efficiency



Outside boilers and boiler controls subject to severe weather, with temperatures as low as 10°F. Except for the central control panel, the Copes-Vulcan control system is entirely outdoors. Each boiler has a maximum continuous rating of 150,000 pounds per hour at 230 psig saturated.

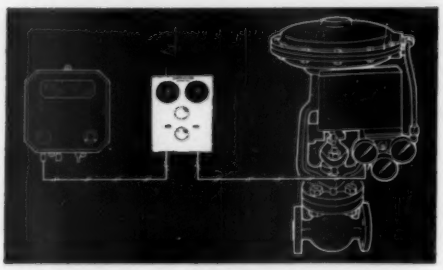
Copes-Vulcan boiler control meets unusual load conditions at Deepwater Station

Besides producing power for the Atlantic City Electric Company system, the Deepwater plant delivers steam to an adjacent chemical plant for process use.

To meet the fluctuating process demands, Copes-Vulcan controls the two low pressure boilers with precision responsiveness.

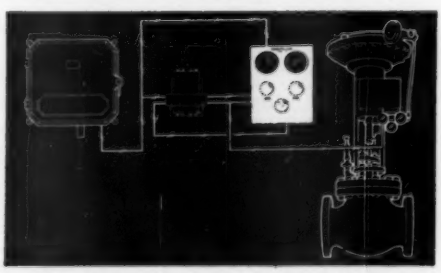
The system consists of: Combustion control . . . Copes Type 3-L Feedwater Control . . . Boiler feed pump recirculation control . . . and Vulcan rotary soot blowers. The system controls all equipment, permits each boiler to carry a different load. Control is automatic through the load range from 20,000 to a peak-load of 200,000 pounds per hour.

Whether your boiler is large or small, power or process, Copes-Vulcan can provide a unit or an integrated package, custom designed to your requirements. For details on the Deepwater Station, write for Bulletin 1057.



PNEUMATIC CONTROL STATIONS. Copes-Vulcan stations offer automatic-to-manual selection without the complication of seal balance. They indicate process-variable, controller, and manual loadings. Transfer is "bumpless" without process disturbance. Write for Bulletin 1031.

The AM-4 Selector Station (shown above) indicates an automatic loading—or originates a manual loading to the valve, power cylinder, or other control elements.

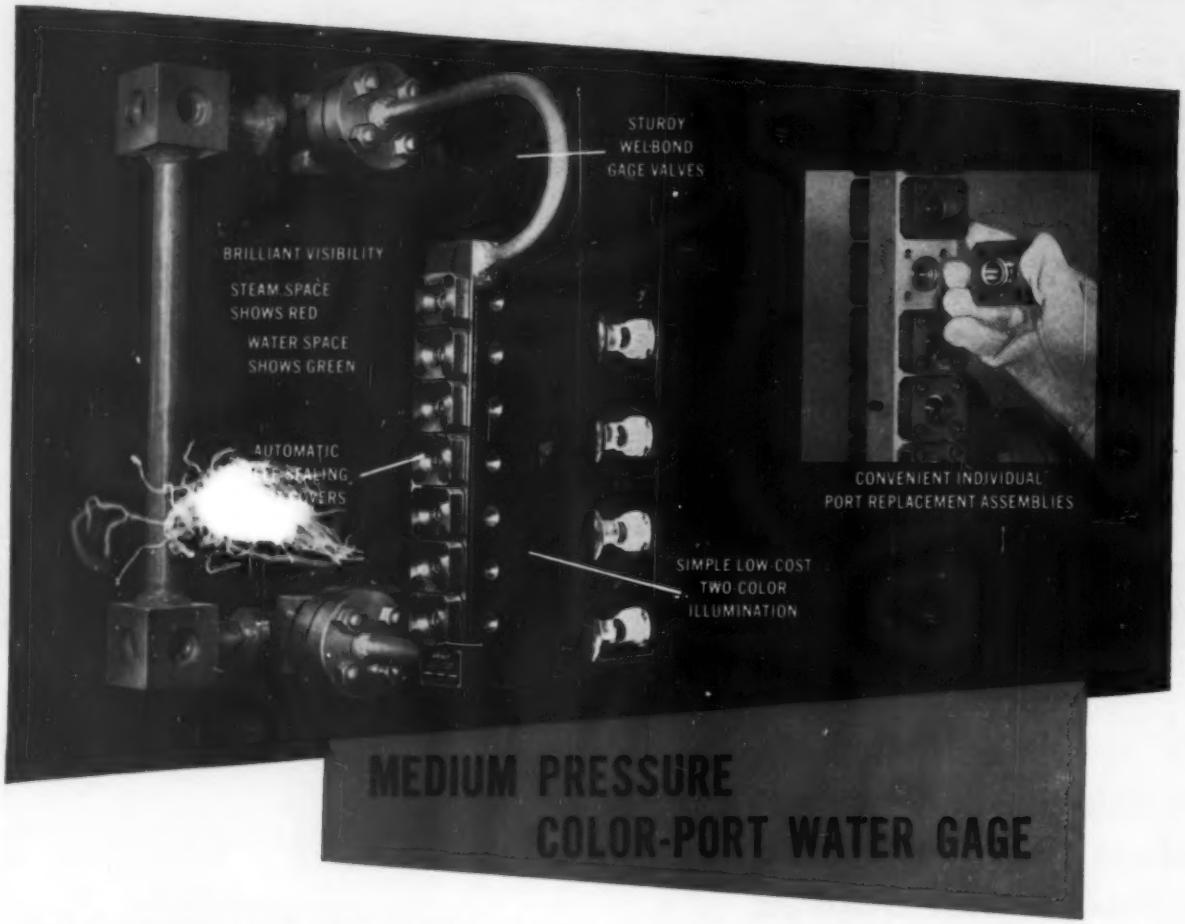


The AMS-4 Remote Set Station (shown above) permits manually adjustable set-point loading, or independent manual operation, of the control element.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

For more data circle 547 on Post Card

NEW YARWAY MEDIUM PRESSURE WATER LEVEL GAGE FEATURES HIGH PRESSURE DEPENDABILITY



These advantages, so successful in high pressure* Yarway Color-Port Water Level Gages, are now incorporated in the new Yarway Color-Port for boilers operating up to 1050 psi.

- Bright red and green readings. Full gage shows all green; empty gage, all red.
- Low maintenance. Individual port assemblies can be replaced in a matter of minutes—with the gage in place. Efficient illuminator spotlights reduce lighting costs.
- Automatic self-sealing ports. Exclusive spring loading of port covers maintains proper pressure on glasses and gaskets at all times.
- Sturdy Yarway Welbond Gage Valves for positive, dependable shut-off service.

For replacement on existing medium pressure boilers or specifying on new units, make sure your next gages are YARWAY COLOR-PORT. Visibility ranges of 13″, 15½″ and 18″ available.

Write for new Bulletin WG-1815.

*up to 3000 psi

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

For more data circle 548 on Post Card

TRACERS

Power Engineering's Monthly Probe of Power Facts

A new fault pressure relay which uses a unique equalizing feature to prevent false operation has been introduced by GE. Called Type J, the relay responds only to internal transformer faults and not to line through-faults, system surges, or mechanical shock and vibration.

In solving its waste disposal problem, Kodak Park Works has cleverly seen a way to win an extra dividend in the form of additional power supply for the Works. In the article on page 77, Harry Eustance explains how the new Kodak waste treatment system includes a hydroelectric generator which is producing 300 hp at a rate of 20 mgd of waste flow.

First operating circuit of superconductive, deposited-film, electronic devices was announced recently at a meeting of the Solid State Devices Research Conference at Cornell University. This was accomplished by a team at Arthur D. Little, Inc, working under Albert E. Slade, and is considered a milestone in the research program to produce an electronic switching circuit that will drastically reduce computer construction costs.

Plant Crisp — the country's first power plant to combine gas and steam turbine in its original design — has been operating since September, 1958. Why was it built for this unusual combination and what are the important operational details? W. Dan Sinclair gives a first-hand answer in his article on page 70, and traces those details which resulted in building the plant for $131.60 per kw.

New concept in the industrial gas turbine field is based on a modified Pratt & Whitney Aircraft J-57 jet engine, which will drive a Cooper-Bessemer designed gas turbine, thus converting the jet's massive thrust into commercially usable horsepower. Experimental prototype of the complete gas turbine unit is under construction at the Mount Vernon, Ohio, plant of Cooper-Bessemer.

Demonstrated for the first time recently, silicon transistors, capable of controlling over 5 kw of power, are announced by Westinghouse as the highest power transistors yet developed. The new devices are suited to high power switching and linear power applications, will soon be available.

Smokeless furnace is reported to have been perfected in Sweden and to be ready for manufacturing. Testing at a combustion efficiency of over 99 per cent, it's the work of Swedish engineer Sven Wernheim. Tars, vapors and gases produced in primary combustion are passed through a diversion disc and down through two return channels to the rear wall of the furnace. The gases are compelled to pass through the burning material, where they are reduced to combustible gases, which in turn are burned in the gas combustion chamber between the two return channels together with the secondary air.

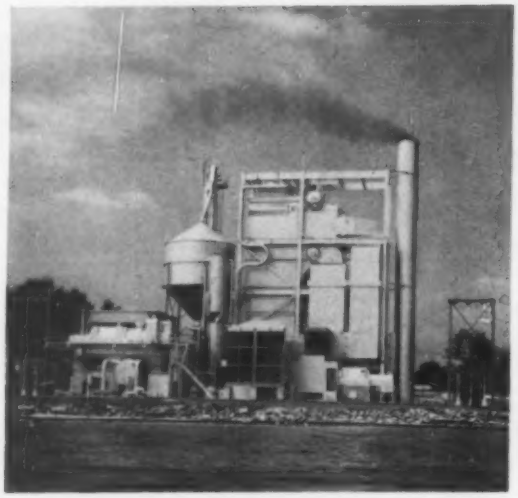


Fig. 1. (Left) General view of Plant Crisp from the water

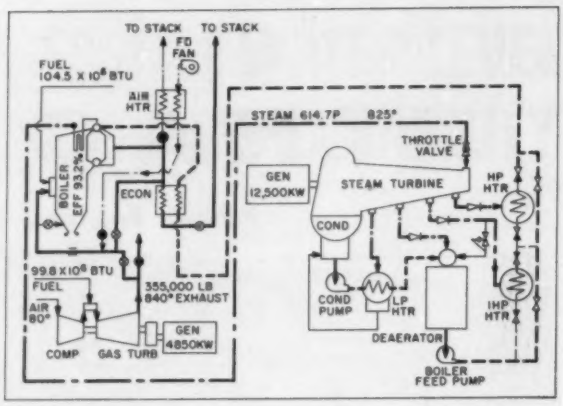


Fig. 2. Heat balance for Plant Crisp at its maximum rating

Why and How We Built Plant Crisp

Standard, readily-available equipment forms a 17,500-kw gas-turbine-steam-turbine plant for $131 per kw, generating electricity for 5.39 mills per kwh. Here are the unusual details of its background and some of the unapparent features making these results possible

By W. DAN SINCLAIR *

BECAUSE SO MANY descriptions of Plant Crisp have been published, power engineers now know that it is the first plant in this country designed specifically to combine the gas turbine and the steam turbine in its original design. They know that Plant Crisp, located at Warwick, Georgia, was built by the Crisp County Power Commission, Cordele, Georgia; that it is a completely outdoor plant; that it has a total capacity of 17,500 kw — 12,500 kw in a steam turbine and 5000 kw in a gas turbine. These and many other details of the completed station have been fully described (see references at end of article).

However, a number of the factors that led to the design of this particular plant, certain details of the way it was built, and the results obtained since it was put into operation in September, 1958, have not been brought out, but should be of interest to power engineers.

Crisp County Power Commission is a county organization serving industrial and domestic consumers with power in an area of 296 sq mi. The commission has supplied this power from a hydroelectric plant on the Flint River at Lake Blackshear. This hydroelectric plant contains four hydroelectric generating units with a total capacity of 17,000 kva. But as the industrial and domestic loads increased, more generating capacity was required.

The Commission has financed all its power operations by means of its own bond issues, paying them off from the customer revenues, and charging rates for power lower than, or comparable with, those in other parts of the region. Accordingly, in planning new additional capacity, we anticipated no difficulty in financing it.

Because there was not sufficient water flow in the Flint River for further expansion of the hydro plant, we had to consider the addition of needed capacity in a thermal plant. We had a daily peak load condition, together with the base load condition, especially at times of low water in the river when the hydro plant production was curtailed. So a thermal plant had to satisfy these requirements reliably, economically, and efficiently.

Our extensive research of this problem, in coöperation with our consulting engineers, Patchen and Zimmerman, led us to our present solution. Starting from zero, without the necessity for adding to an existing station, we decided to utilize the most modern ideas of plant design and construction that seemed practical.

* Manager and Chief Engineer, Crisp County Power Commission, and Consultant, Kaiser Engineers

Now, for some time, power engineers have been discussing the great advantages of the gas-turbine-steam-turbine combination. However, up to now, gas turbines have been combined with steam turbines in this country only in existing steam plants. For example, one utility station uses gas-turbine exhaust to heat feedwater

Why This Article

Many detailed descriptions of this first combination plant have been published. But not too much has been said about some of the unusual features underlying its design, the methods by which it was built, and results obtained with it. They are reviewed here, in the belief that they should stimulate thinking about the possibilities of combining the gas turbine and steam turbine, especially in small- and medium-sized plants for industrial and utility use. In the August, 1958 issue of POWER ENGINEERING, author J. O. Stephens explored this combination thoroughly in his article, Why a Combined Steam and Gas Turbine Plant?

Fig. 3. Reinforcing steel after being hoisted into place by crane. This foundation is for the gas turbine and exciter

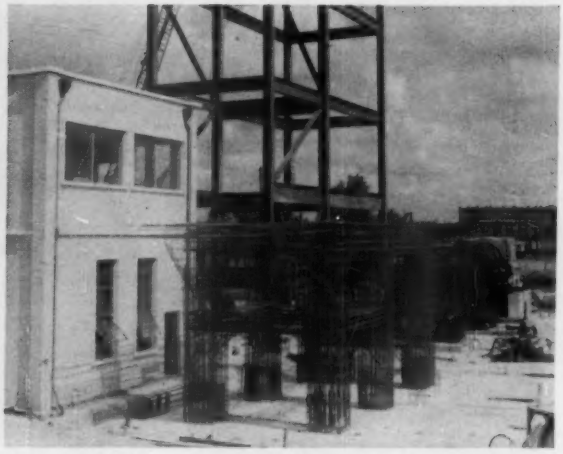


Fig. 4. Here the steel for the steam-turbine foundation is ready for concrete. Gas turbine is covered in the background

in the steam cycle. In one industrial power plant, a gas turbine was added to and superimposed on an existing steam turbine plant.

Our studies showed us that we could meet our peak loads and base loads economically by a plant using all the latest ideas in combined operation, outdoor construction (very good in our climate), centralized control to minimize attendance, and other modern features, all with conventional equipment readily obtainable in the capacity range desired.

We were determined that the plant must be built at lowest possible capital cost, that it must have highest possible thermal efficiency, and that it must operate with minimum personnel and lowest possible maintenance cost.

We made load studies and evaluation studies of all the different types of equipment that could be economically put into the cycle, including a nuclear reactor plant. As a result, we determined that a 12,500-kw steam turbine and a 5000-kw gas turbine would give the most economical results in combination with the four units installed in the hydro station.

Fuel studies showed that coal and natural gas in combination would give the lowest fuel cost, the gas being available on a maximum interruptible basis of 45 days a year.

Finally, we studied carefully the selection of specific equipment and specified standard repetitive-manufactured apparatus. This not only kept initial cost at a minimum, avoiding more expensive specially-built equipment, but also assured us of readily-available spare parts at normal cost.

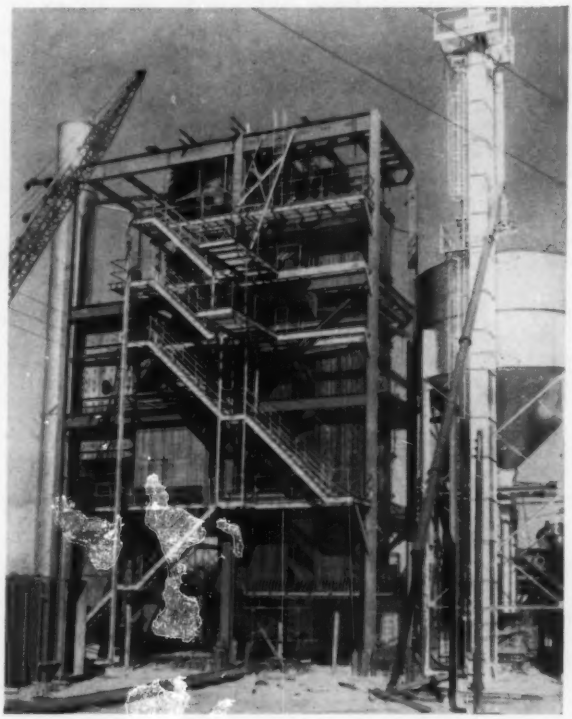


Fig. 5. (Left) Boiler prior to installing the furnace walls. Tabulation (Below) of production costs, 8/1/58 to 2/1/59

Item	Pulverized Coal Firing	Combined Cycle
1. Heat Rate Btu/Kwh	13,026	12,035
2. Lb Coal/Kwh	0.962	0.826
3. Station Thermal Efficiency	26.2%	28.4%
4. Station Service Demand, Kw	492	418
5. Station Service Kwh expressed as a percentage of total Kwh output	7.02%	4.70%
6. Make-up Water Rate	1.87%	1.87%
7. Fuel Cost, Mills/Kwh	4.75	4.40
8. M & O Cost, Mills/Kwh	0.317	0.350
9. Annual Fixed Costs, Mills/Kwh* (Based on 80% load factor)	0.636	0.636
10. Total Production Cost, Mills/Kwh	5.70	5.39
11. Station Load Factor % (For six-month period)	18.8%	
12. Coal Cost, cents/MBtu** (Delivered)	30.05	30.05
13. Gas Cost, cents/MBtu (Delivered)	36.0	36.0

Note *: Annual Fixed Costs do not include any depreciation because plant is new. Depreciation rate will be .00066 mills/Kwh based on 80% annual load factor. Amortization will be set up on a 25-year basis.
Note **: Price reflects $0.15/ton increase in coal cost, effective Jan. 1, 1959.

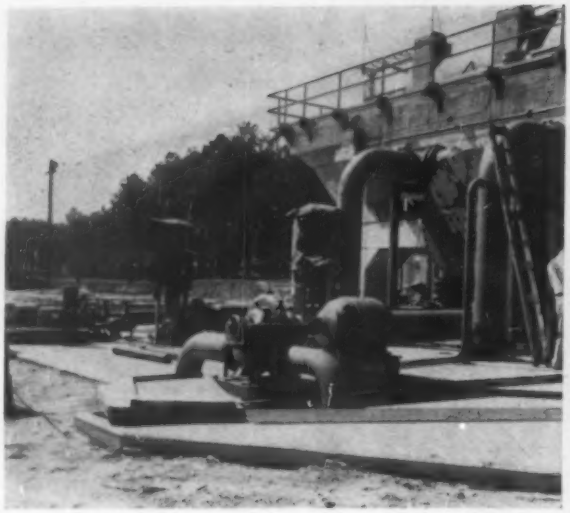


Fig. 6. Turbine showing above condenser and pedestal, with the circulating water pumps and service pumps in foreground

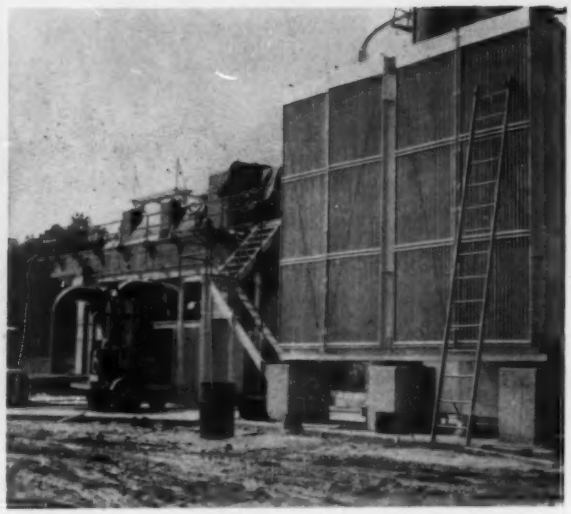


Fig. 7. This is the over-sized economizer in which the gas-turbine exhaust heats boiler feedwater for the steam cycle

As a result, the plant consists of: a G-E 12,500-kw, 3600-rpm straight-condensing 600-psig, 825-F steam-turbine generator; a C. H. Wheeler 10,000-sq ft condenser; a 5000-kw G-E simple-cycle single-shaft 6900-rpm gas turbine, driving a 2400/4160-v generator through a reduction gear; a B & W 130,000-lb-per-hr, 625-psig, 850-F boiler designed for pressurized operation, for firing pulverized coal, oil or gas alone, or in combination with the exhaust from the gas turbine; an oversized economizer; and the necessary auxiliaries. (Complete list of equipment, Ref 1.)

On the steam turbine deck, near the turbine control end, we grouped all valves for feedwater heaters, steam-jet air ejectors, and other auxiliaries, so that an operator has them all in one location, easily accessible for starting and stopping.

Only part of the plant fully enclosed (and air conditioned by a heat pump) is the control room at steam-turbine deck level, from which the control operator can walk out directly to the turbine, and the group of control valves just mentioned.

We saved time and money by assembling all the reinforcing steel for the various pits and above-ground foundations in a wooden form, Fig. 2, and then hoisting it as a unit, with our traveling crane, onto the foundation mat. Several weeks of construction time were saved by this method on the water intake structure and the coal hopper pits.

The gas turbine was set at ground level, Fig. 10, including its generator and exciter. The coal pulverizers, with a 250-ton coal storage silo overhead, shown in Figure 1, are also on ground level, also pumps and other auxiliaries.

Because land and water were already available at the site of the hydroelectric plant, the new thermal plant was located there. Raw water

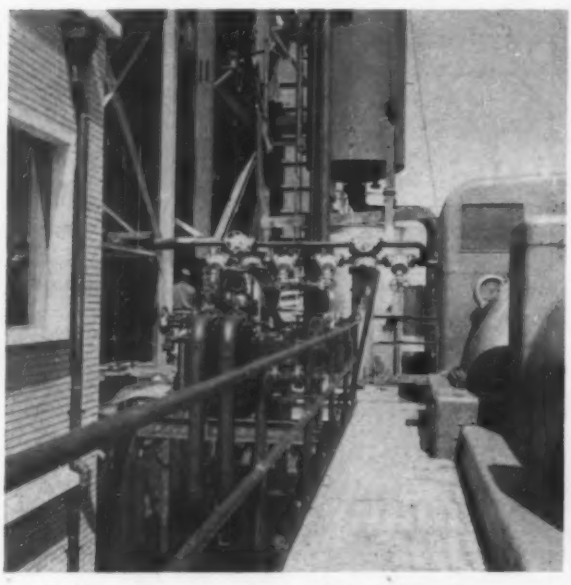


Fig. 8. Operator's view leaving control room shows ready access to heater and air ejector valves beside turbine

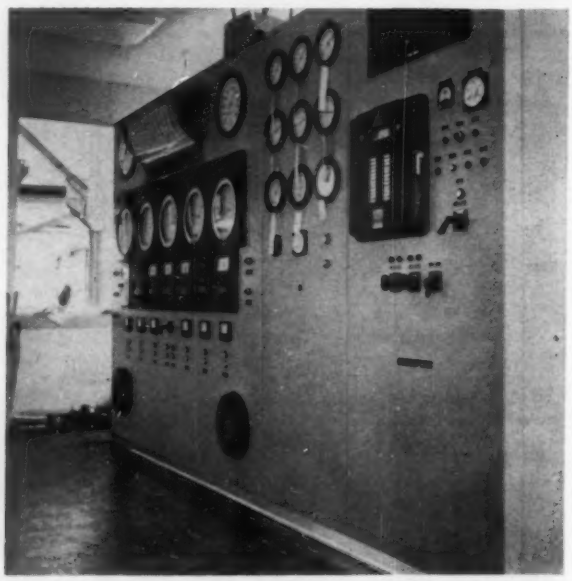


Fig. 9. Control of the two units is centered here, where a water-source heat pump furnishes all-year air conditioning

for boiler feed comes from a well and is treated by zeolite type of demineralizer. Condenser circulating water is pumped from Lake Blackshear by vertical circulating pumps and discharges to a basin above the hydro plant.

In placing the equipment, we used some new ideas to lower cost of operation and maintenance. For example, all equipment rests on a concrete mat just below ground level, as shown in the photographs, except the steam turbine generator, which must be over the condenser, on a pedestal 17 ft above ground.

In constructing the foundation mats, we put all the piping possible in pipe trenches with drains and removable covers for access. The piping is supported from the trench wall by brackets, is not buried in concrete, therefore is readily accessible for repairs or additions. Over the foundation base slabs, we put a 12-in. layer of clay and a 6-in. concrete floor slab on top of that. This provides a way to make changes in plant equipment without disturbing the main foundation base. The foundations are of the unit type; that is, one base slab each for the boiler, the coal pulverizers, the gas and steam turbines, and the central building.

We handle coal by elevating it to a hopper over the pulverizers, at a rate of 50 tons per hour, with a by-pass to an adjacent storage yard. We dispose of ash by a simple hydraulic ejector system. Vertical-lift condenser circulating pumps are set, Fig. 6, with the bottom of the pumps and the discharge pipes at the same level. Hence, when the condenser is filled with water, little power is required to maintain flow.

The boiler is insulated so its face temperature does not exceed 80 F above ambient. All outside piping, including control piping, is insulated. These and other details are given more fully in Ref 1.

In operation, the plant starts up as follows. The gas turbine can be started and put on the line in 20 min and loaded in another 5 min. The procedure is to start the gas turbine and use the exhaust gas to heat up the boiler to full operating steam pressure of 625 psig. Then the steam turbine is warmed up and loaded to 3000 kw. Thus the gas turbine is generating 5000 kw and supplying heat to the boiler and turbine for 3000 kw. Later the burners in the boiler can be lighted-off and more electrical load picked up as required. Burner light-off is simple and safe because the furnace is already hot.

Either machine can be operated separately or the two together. Of the gas-turbine exhaust, under combined operation, two-thirds goes to the large economizer, to heat feedwater, and the remaining one-third forms combustion air for the boiler. The gas turbine supplies the forced draft for pressurized boiler operation on the combined cycle but a forced-draft fan is provided for it when the gas turbine is shut down. Part of the gas-turbine exhaust gas is injected into the bottom of the furnace; thus superheat temperature can be controlled down to 40 per cent load on the steam turbine because the exhaust blankets the furnace walls and directs the burner flames toward the superheater.

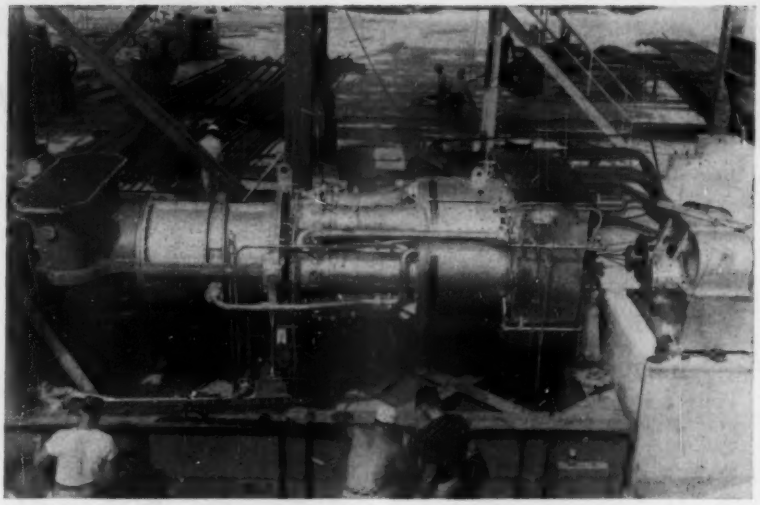


Fig. 10. Gas turbine being aligned during construction. Exhaust is on the right

Controls, all centralized in the control room, permit manual or automatic operation under combined firing or coal firing conditions. Dampers in the air system may be actuated by manually-controlled electric motors or by the automatic controllers. Change-over from one type of operation to the other can be made without any thermal or pressure drop in the duct system. The plant is operated by two men, one in the control room, the other looking after equipment outside; and a third man on the morning shift unloads coal.

As a result of attention to details like this, we built Plant Crisp combination gas-steam-turbine plant for $131.60 per kw. Our records show it operates at a heat rate as shown in the table. But this design was made to provide for future expansion. The present 5000-kw gas turbine has the capability of supplying combustion air for 45,000 kw of steam capacity. So the next steam unit will be a 30,000-kw machine and a second boiler of 310,000-lb-per-hr capacity. Thus, all the gas turbine exhaust will be used directly in the furnaces and, because of elimination of air heaters and forced-draft fans on two boilers, we might expect an over-all station thermal efficiency of approximately 32 per cent. THE END

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1. Application of the Gas Turbine on a Combined Thermal Cycle; W. Dan Sinclair; paper at AIEE-ASME meeting, Atlanta, Ga., 1959.
2. Why a Combined Steam and Gas Turbine Plant; J. O. Stephens; POWER ENGINEERING, August, 1958.
3. Plant Crisp Combines Steam and Gas Turbines; Ron Ross; *Public Power*, January 1959.
4. Gas Turbines Team up with Steam Turbines for Economy; *Power*, October 1958.
5. New Cycle for Gas-Steam-Turbine Plant, *Southern Power & Industry*, March 1958.
6. Combined Gas-Steam-Turbine Plant; *Mechanical Engineering*, January 1958.

Transmission Line Reprints Available

Electric Transmission Lines: How to Design and Build Them is the complete story of how a typical electric transmission line is conceived, designed, and constructed. This three-part article, which recently appeared in POWER ENGINEERING, has been reprinted and is ready for the power engineer who needs a good guide to all phases of electric line construction. E. P. Naney of Interstate Power Co, the author of this important work, is a power engineer who has spent many years in this field. Write for your free copy or ask for quantity lot prices by addressing the Editor, POWER ENGINEERING, 308 E. James St, Barrington, Ill.

Maine P S Installs 4200 Kw in Diesel Power for Peaking

When the need for peaking capability became apparent, and economic studies dictated that diesel engines, installed at less than $100 per kw, would be the best, MPS acted promptly. This is the result

By J. D. WADDELL*

THE MAINE Public Service Company is a typical electric utility. While it is typical in many respects and compares favorably with other privately owned and operated companies of comparable size, its structure is affected by its geographic location and by its two major business enterprises — potatoes and forest products.

In a carefully-planned move, MPS has just installed and put into service a 4200-kw diesel peaking unit, consisting of three 1400-kw diesel engines and a control "pod". Designed by the manufacturer, Electro-Motive Division of General Motors, to start automatically, by remote control, from start to full-load in 90 seconds or less, the new plant, strategically located at Presque Isle, Me., seems ideal for its purpose. Fig. 1 illustrates the basic engine which has been used.

In order to understand the factors leading to the decision to install peaking diesel generators, it is desirable to review a little of the history of the company. The operating area essentially extends some 120 miles north to south and 30 miles east to west. Most of its facilities and load are located in the eastern half of Aroostook County, which comprises a large part of northern Maine. Part of Penobscot County is served, as well as a large part of the Saint John River valley area of the Province of New Brunswick, Canada. Canadian operations are handled through the wholly-owned subsidiary Maine and New Brunswick Electrical Power Company, Ltd.

Contributing to Progress

Shortly after the original hydroelectric installation was made at Aroostook Falls, New Brunswick, the Maine and New Brunswick Electrical Power Co, Ltd, was incorporated in New Brunswick in 1903. The Gould Electric Co was incorporated in the State of Maine in 1917 with headquarters at Presque Isle. Arthur R. Gould, the founder and owner, was truly one of the great pioneers in the electric utility field.

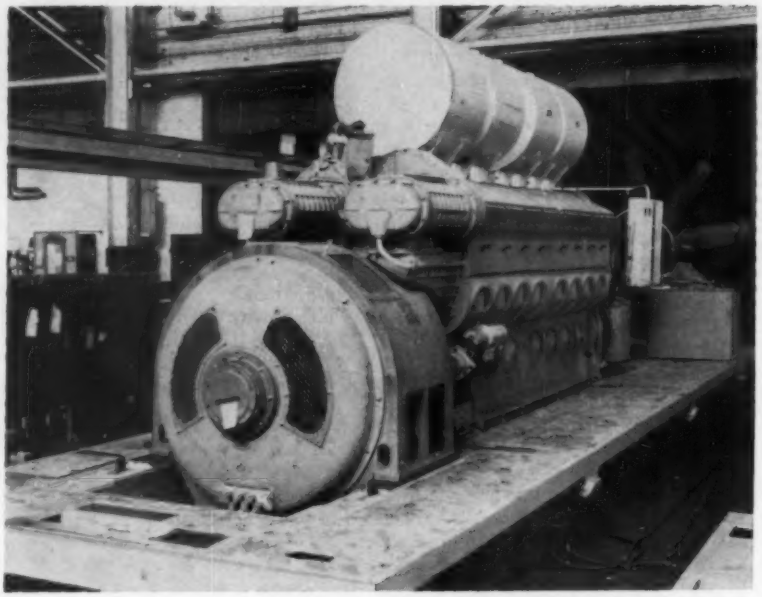

Fig. 1. Engine, generator, and silencer, before the installation in its cubicle

In 1929 the company name was changed to the present Maine Public Service Company. In 1942 the common stock of the Maine and New Brunswick Electrical Power Co, Ltd, was acquired. Prior to April, 1947, the company was a subsidiary of the Consolidated Electric and Gas Co, a holding company.

Operating History

During the period up to December, 1947, the company had enjoyed relatively rapid expansion due to load growth and acquisition of several small distribution properties in its operating area. Up to this date the only generating units on the system were the hydroelectric installations, located at Tinker (Aroostook Falls), Caribou, and at Squa Pan Lake plant, 8380 kw, 900 kw, and 1200 kw, respectively. The company essentially depended on good water conditions to meet its 1947 winter peak load requirements, while proceeding with construction of a 7000-kw diesel generating station in Caribou.

Water conditions were seriously adverse in 1947, however, with the result that the company was forced to two measures over the winter peak: 1. ration electrical service to its customers; and 2. obtain emergency assistance wherever possible. Energy was obtained by displacement from U. S. Navy ships at South Portland and by installation of diesel generator units obtained from various sources. The company also rushed to completion its new diesel station and placed in service the first and second units in December, 1947 and January, 1948.

Water conditions materially improved in 1948, but the major improvement was due to the better scheduling of available water, which was permitted by the diesel generation of the system. The operating crisis which had occurred resulted from inadequate water storage capacity and from having only hydro generation available on the system. The addition of diesel generation to the system materially improved the operating situation from the stand-

* Vice President, Maine Public Service Co

point of meeting the system peak but did not compensate for the vagaries of nature with respect to water requirements for hydro generation purposes.

The first steam unit, having 9000-kw capability, was placed in service in November, 1950. In 1951 another 1000-kw diesel generator was added at Caribou, and a 1500-kw horizontal hydro generator at Tinker was replaced by a 3520-kw vertical unit. By 1952 the total generating capability was as follows: 12,700-kw hydro; 9000-kw steam; and 10,100-kw diesel for a total of 31,800 kw. The winter peak of 27,800 kw came Christmas week, leaving a comfortable 4000-kw reserve.

Other system changes were taking place, meanwhile, not only by addition of generation, but also by extension of the transmission system and by building parts of its transmission facilities for conversion to 69 kv. System load growth was somewhat above the national average each year. In 1953 the backbone transmission system was completed. In July, 1955, No. 2 turbo-generator, 12,650 kw, was placed in service at Caribou. The total system generating capability at this time became: steam, 21,650 kw; hydro 12,700 kw; and, diesel 10,100 kw — for a total of 44,450 kw.

While there was a temporary respite from a deficiency of generating capability, the management recognized the need to study its operating problems with a view to more economical methods. This study was made more urgent by: 1. the cost of transporting fuel oil to northern Maine; 2. the possibility of adverse water conditions for hydro purposes; and 3. the continued above-average load growth. The study was materially aided by hydro and rainfall records kept for the Aroostook River watershed over some 15 to 18 years.

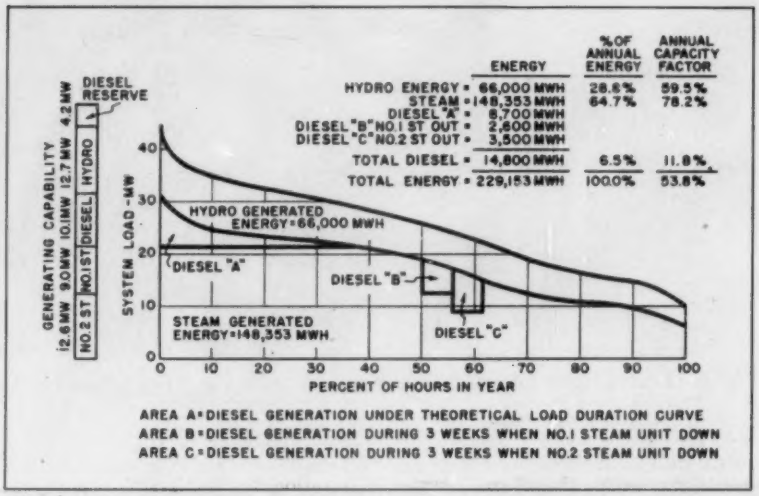
ENERGY
% OF ANNUAL ENERGY
ANNUAL CAPACITY FACTOR
HYDRO ENERGY = 66,000 MWH 28.8% 59.5%
STEAM = 148,353 MWH 64.7% 78.2%
DIESEL "A" = 8,700 MWH
DIESEL "B" NO.1 ST OUT = 2,600 MWH
DIESEL "C" NO.2 ST OUT = 3,500 MWH
TOTAL DIESEL = 14,800 MWH 6.5% 11.8%
TOTAL ENERGY = 229,153 MWH 100.0% 53.8%
GENERATING CAPABILITY
DIESEL RESERVE 4.2 MW
NO.2 ST 12.6 MW
NO.1 ST 9.0 MW
DIESEL 10.1 MW
HYDRO 12.7 MW
SYSTEM LOAD - MW
HYDRO GENERATED ENERGY = 66,000 MWH
DIESEL "A"
DIESEL "B"
DIESEL "C"
STEAM GENERATED ENERGY = 148,353 MWH
PERCENT OF HOURS IN YEAR
AREA A = DIESEL GENERATION UNDER THEORETICAL LOAD DURATION CURVE
AREA B = DIESEL GENERATION DURING 3 WEEKS WHEN NO.1 STEAM UNIT DOWN
AREA C = DIESEL GENERATION DURING 3 WEEKS WHEN NO.2 STEAM UNIT DOWN

Fig. 2. Annual load curves demonstrate good load factors, but point to a need for economical peaking power, which, after study, is now fulfilled by diesels

The study included not only consideration for the most economical scheduling of generation and transmission on the system, but also the possibility of favorable purchase-power or power-interchange contracts. The company now has a purchase-power contract with an emergency interchange clause with Loring Air Force Base. In addition, a 69-kv transmission circuit was built and placed in service in 1957, interconnecting the company system with that of The New Brunswick Electric Power Commission. The contract provides for the interchange of economy energy as well as emergency requirements.

This latter interconnection has permitted both parties to obtain excess capacity from time to time at a rate more favorable than that which could be obtained from its own generation. There have been a few instances where both parties have been materially assisted in emergencies. Interconnections with other systems have been mutually advantageous on many occasions. This suggests the desirability of further study by the parties concerned to determine if further economies can be effected. The interconnected electrical systems at present are: Fraser Paper Limited at Madawaska; Loring Air Force Base; The New Brunswick Electric Power Commission; and the Bangor Hydro-Electric Co at Medway.

Stone & Webster Service Corporation in 1959 made a system capacity study with a view to determining the most economical basis of providing for system requirements for the next several years. Other studies have resulted in the conversion of the backbone transmission system from 34 kv

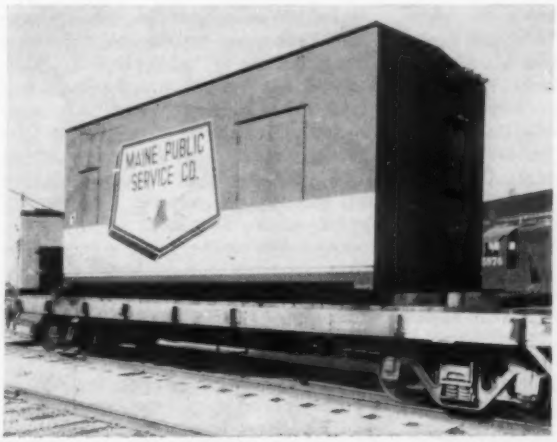

Fig. 3. This is the control cubicle, prepared for shipment

Fig. 4. Diesel locomotive pulls three more diesels into town

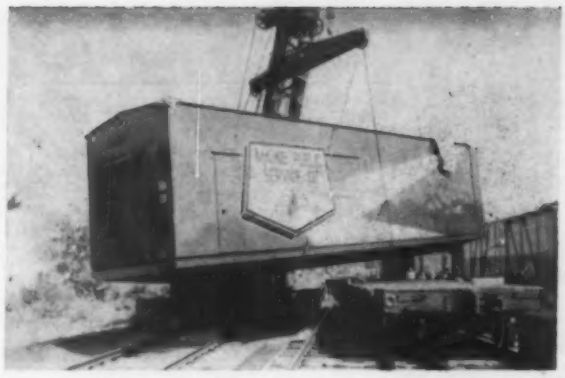

Fig. 5. Railroad crane unloads one engine for its short trip

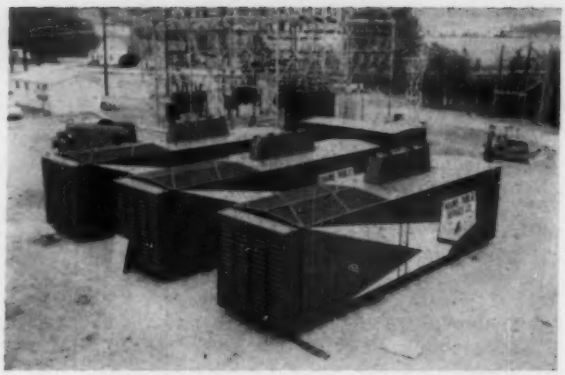

Fig. 6. Assembled and in operation, 4200 kw of diesel power

to 69 kv and in consideration of additional hydro capacity through storage and generation.

In their study Stone & Webster considered many aspects of the matter, some of which are peculiar to this operating area. A comparison was made of fixed charges and operating costs for diesel and steam units. Load factors, fuel costs, size of units, rate base, economy energy, reserve requirements, and duration of loads were some of the aspects analyzed.

It was determined for the company that system-peaking diesel energy at this time is more economical than steam energy below load factors in the order of 53 per cent. Although fuel and lubricant costs per kwh are higher for diesels, the smaller fixed charges associated with a peaking diesel installation overcome the difference in operating costs until high load factors (above 53 per cent) obtain.

Load Curves

Load duration curves were prepared and studied. One such curve is shown in Fig. 2. The various sources of generation on the system are shown. The 21,650-kw steam generation is shown as base load, the 12,700 kw of hydro generation supplies the peak load with diesel generation and purchased power, making up the balance of the required energy. This shows that 64.7 per cent of the 1959 energy requirements will be taken off steam units, 28.8 per cent off hydro units, and 6.5 per cent off diesel units or purchased.

Data of the characteristic curve show that 23 per cent of the time the system peak is above 71.7 per cent kw; 5 per cent time, above 82.7 per cent peak; 1.0 per cent time, above 91.0 per cent peak; 0.3 per cent time, above 96.5 per cent peak; and 0.09 per cent time, above 99.1 per cent peak. The annual load factors are shown for the types of generation. It can be seen from the chart that the system load duration curve is characterized by a sharp peak which represents very little energy over the relatively short period of time.

Estimated peak load in December, 1959, is 43,800 kw. From the previously-listed generating capability, it is apparent that at the time of the peak the system will have less than one megawatt of reserve. Should the largest unit not be available at the time of the system peak, a large part of the deficiency could be obtained through interconnections with other systems.

It appeared desirable, however, for the company to add at this time some 4000 kw of diesel generating capability to its system. This amount would immediately provide adequate reserve capacity and provide rate base. The Electro-Motive Division of General Motors proposed the purchase of a peaking diesel generator installation available for such applications. Their proposal specifically related to three 1400-kw diesel generators, separately housed, and one control unit similarly housed.

Careful Analysis

The proposal was investigated. Stone & Webster analyzed the pertinent factors in relation to the company's requirements. It was determined that it was more economical, all factors considered, to purchase the peaking diesel generator units than to purchase capacity from other systems. The units were purchased and have been installed on the transmission system at Flo's Inn Station, just east of Presque Isle.

A 20,000-gallon, above-ground diesel fuel oil tank was installed for the units. The size of the tank was dictated by several factors, among which was the possibility of a fourth diesel unit. The units have been connected for individual start-stop remote operation from the dispatcher's office. A routine weekly inspection is made by station maintenance personnel.

While a bank of station-service transformers was provided with the units, the company provided station service from an outside bank of transformers. This was done in order to permit clearing of the main 6000-kva transformer from the bus during periods of diesel inoperation, thus avoiding transformer losses. The transformer switch is remotely controlled by the dispatcher.

Dispatcher In Command

Red and green lights on the board indicate the open-close position of the circuit breaker. Total output can also be read remotely. Should one or more units fail to start up and synchronize on the bus properly and automatically, or should one or more units trip out for any reason, the dispatcher will have immediate knowledge of the change and have the station inspected.

A period of operation will permit sufficient cost-of-operation data to be accumulated, from which it is expected that the dispatchers will be able to schedule one or more of the units on an economical basis along with other generating units and/or purchase power.

It is too early to predict operating costs. There is no doubt, however, that the installation is the most economical method at this time of obtaining the required peaking capacity on this system. THE END

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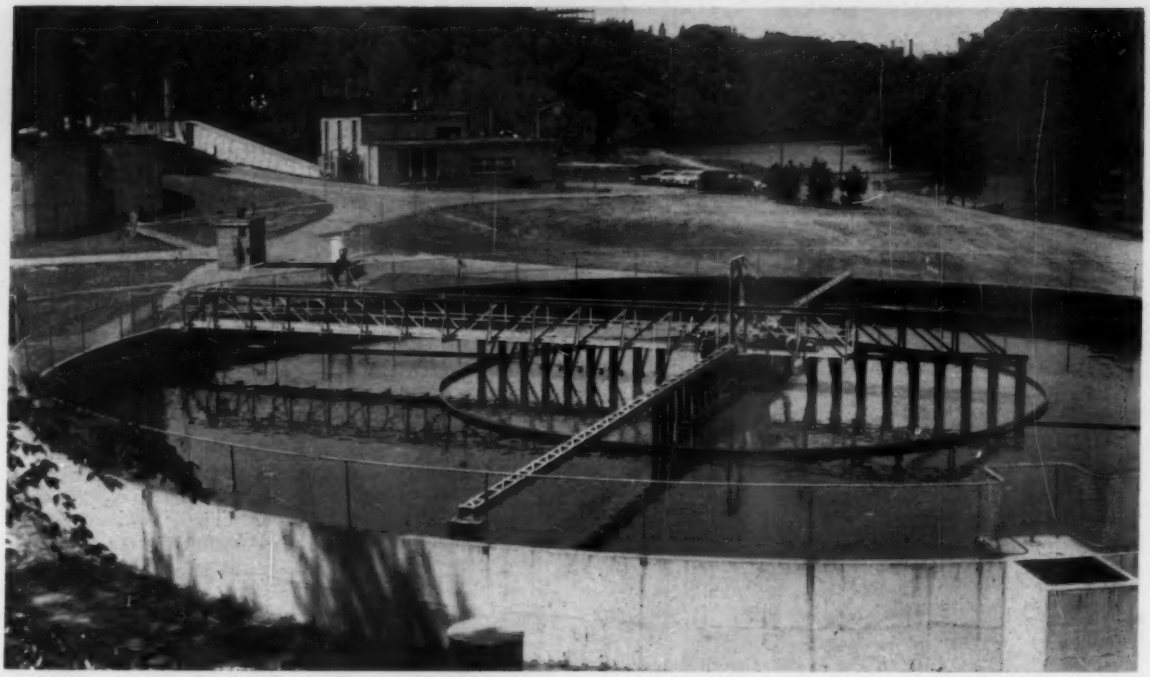

Fig. 1. View of Kodak Park's waste treatment plant on the Genesee River. In foreground one of the two 130-ft-diam clari-flocculator tanks, holding tanks (left), main operations building (rear) where turbine is located. For how of system, turn page

Kodak Park Makes Power from 20 MGD of Treated Waste

Operated by the utilities division at the Kodak Park Works, Kodak's new waste treatment plant has substantially reduced both the volume and effect of process wastes. With a hydroelectric generator built in, it's producing power, too, for use all over the plant

By HARRY EUSTANCE *

INDUSTRY in Rochester, N. Y., especially the photographic industry, was able to grow and prosper here because of the area's fine waterways. Lake Ontario has served as Kodak's basic source of water supply, while the Genesee River, for many years, was able to absorb our neutral wastes without damage to itself.

Kodak's industrial waste comes from water originally processed at our own water filtration plant and pumped six miles to the Kodak Park works, the company's manufacturing plant for photographic films, papers, and chemicals. Here it is used in various manufacturing and cooling processes. The volume is large, averaging 20,000,000 gal per day, and no public sewer facilities are available to receive it. So Kodak is responsible for collecting and disposing of its own used water, which is discharged into the lower river and eventually finds its way back to the lake.

As our industry and others continued to grow, the waste burden placed on the river grew heavier and heavier. In 1957, Eastman Kodak's Waste Treatment Plant was put into operation. Its opening was one more step forward in waste control research and development which had begun more than 20 years before.

Over the years, Kodak people had been watching the river to ensure that our wastes were being readily assimilated. In 1927 a general survey of the waste situation was made, and further investigation in 1930 resulted in the recommendation that sanitary sewage be separated from the combined sewer system which ran through the Kodak Park works. A dual sewer system was installed, and thereafter storm and industrial wastes were completely separated from sanitary sewage. This system resulted in the alleviation of one of our major treatment problems — bacteriological contamination. Although Kodak Park's industrial waste did have a

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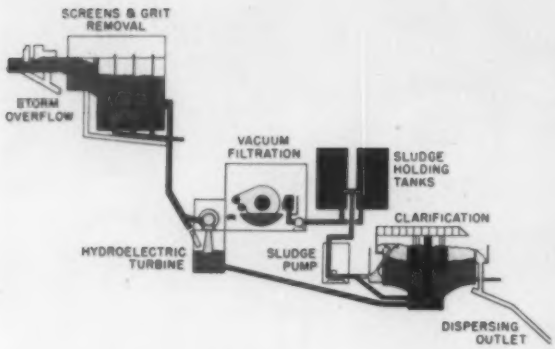
Why This Article

Industry, waterways, and waste form a triangular problem faced by most of our industrial communities. As demand for water as a raw commodity increases, the need for pollution-control of our water resources grows more acute. What the Eastman Kodak Co has done to conserve the quality of its water supply is a stellar example of how one industry solved the problem



Here's how Kodak Park's waste treatment plant works

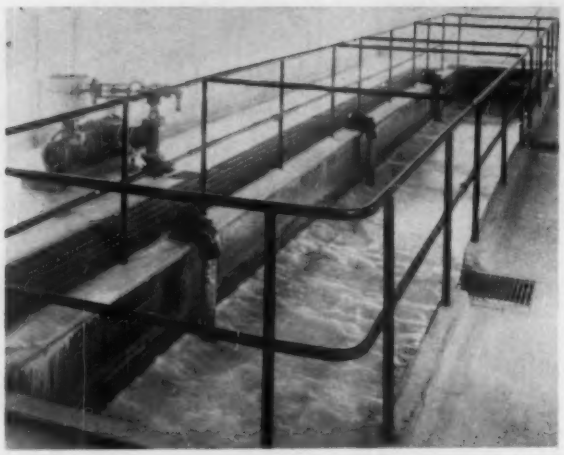


Fig. 2. Treatment process begins at top of hill, 145 ft above Genesee River, where waste-water flows through by-pass chamber to Grit Building. Solids larger than 1-in. in diam, cinders and sand are screened. Flow then goes to hydro turbine

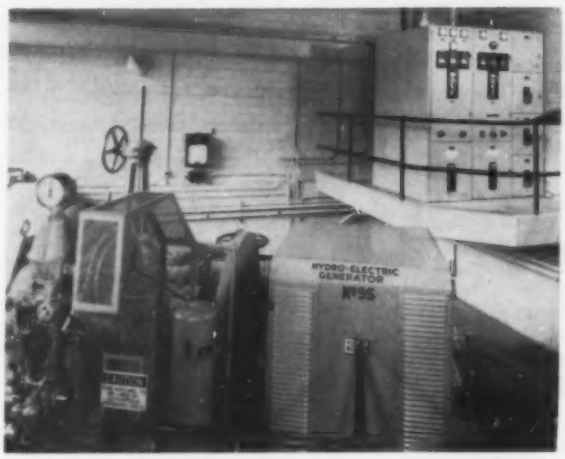


Fig. 3. Waste-flow descends 125 ft to a horizontal hydroelectric turbine in the main operations building. This turbine uses the energy of the flow to generate 300 hp at the present rate of roughly 20,000,000 gallons of flow per day

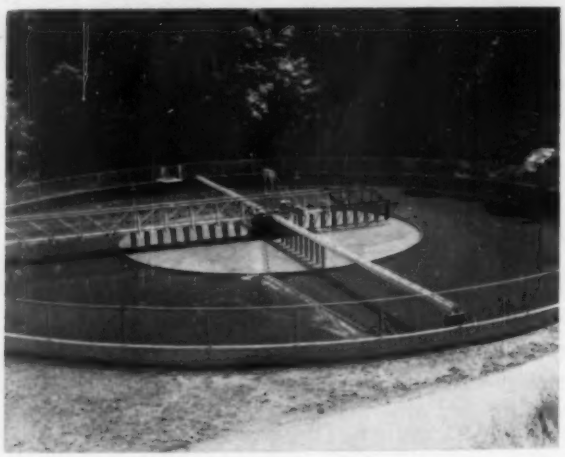


Fig. 4. Within the flocculation or inner-compartments of the two 130-ft-diam treatment tanks sludge is settled out and withdrawn for eventual disposal. Larger or outer chamber clarifies and cleans the water flow for discharge to river

biochemical demand, bacteriological tests proved it to be sterile.

After a 1949 river survey showed the effect of our wastes to be approaching the limit which the river could stand and still remain healthy, Kodak approved a continuing appropriation to support a staff, to finance experiments, and to carry out river and waste investigation. Our investigations resolved themselves into a threefold study: the investigation of river conditions; the study of Kodak waste characteristics; and design of the treatment plant itself.

From the river surveys and the studies of plant waste, we were able to estimate what a treatment plant would have to do to produce an effluent not harmful to the river. The separation of sanitary waste, improved recovery processes, and reduction in waste discharges were great assets, but there still remained many major problems which warranted an intensive six-year program which led to our initial plant designs and pilot plant tests. Among the problems considered were the removal of solids, the prevention of foam formation on the river, color neutralization, and the necessity of as uniform a discharge as possible.

As anticipated, our major problems arose in the development of the most effective and economical means to remove suspended solids from the waste and process these solids for easy handling. Settling characteristics of rectangular and circular tanks with regard to velocity, retention time, overflow rates, and the influence of sludge removal were studied with the conclusion that circular tanks were the most efficient.

There were, however, many ramifications of solids separation which were investigated before this conclusion could be accepted. Even then the acceptance of circular tanks was preceded by many modifications and the establishment of an operation procedure. Early experiments in clarification by gravity were discouraging, because of the tendency for an excessive amount of solids to float on the water surface as scum, sufficient to hinder full-scale operation of the process. Flotation and solids contact methods of clarification

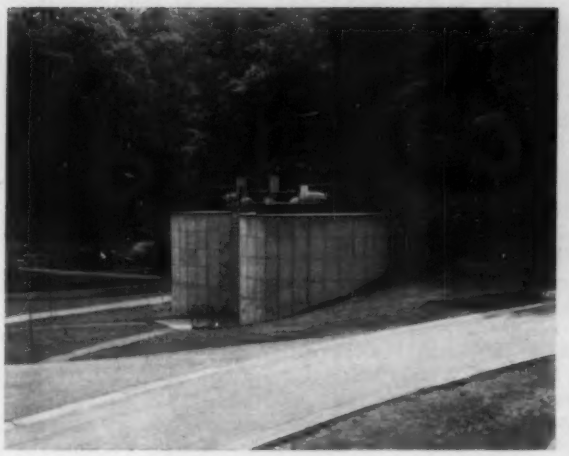


Fig. 5. After clarification the settled-out sludge is discharged into two concrete tanks where it is blended and made more filterable by a 50-hp mixer. Each tank holds about 50,000 gal. Filtration process is controlled automatically

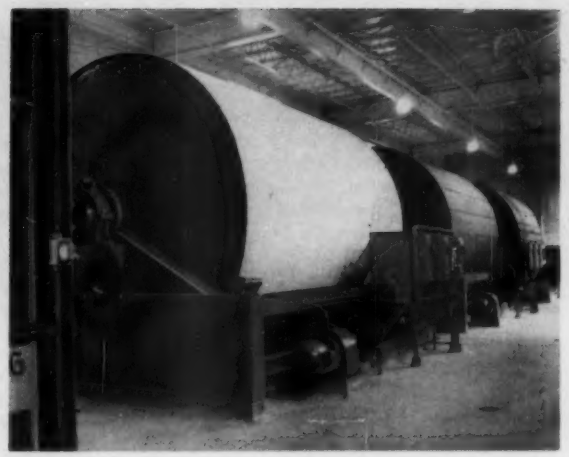


Fig. 6. Sludge is then pumped to main operations building. Here are the three 11½-ft-diam by 14-ft long vacuum filters which dewater and filter the sludge. After filtration treatment here, the sludge is carried to waiting load-lugger bodies

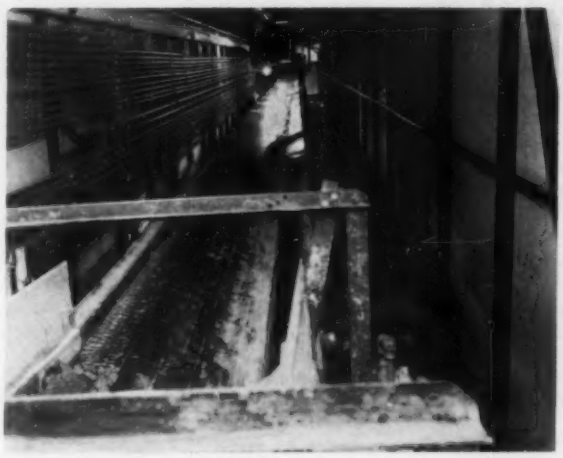


Fig. 7. Here's filtered sludge in a cake form, 30 per cent solids, being carried from operations building by conveyor for disposal as land fill. Sludge filtered averages 90 cu yd a day, and maximum output to date has been about 270 cu yd

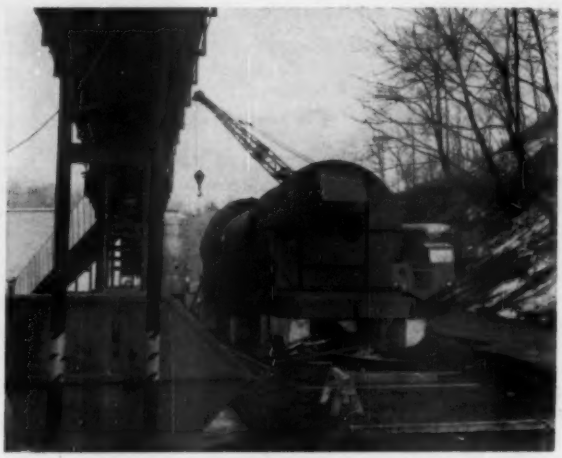


Fig. 8. Land fill method of disposing of sludge is being replaced by this drier-kiln, which will reduce the present sludge volume substantially, leaving only an innocuous ash as the end product of treatment process. At left is conveyor

were investigated and found to be less effective on this waste than gravity separation.

Coagulation and flocculation experiments were initiated on a laboratory scale to determine their effectiveness as aids to clarification and to see if they would warrant pilot plant investigation. It was found in both laboratory and pilot plant studies that mechanical flocculation, without chemical aids, not only increased the efficiency of solids removal but so reduced scum formation that it no longer became a problem to the operation. It was also determined that frequent withdrawal of sludge from the tank was a major contribution to the increased efficiency of clarification. Translated into figures, the following table shows the magnitude of these gains in efficiency:

Type of Process	% Removal Suspended Solids	% Removal Settleable Solids
Straight Clarification	53%	—
Straight Clarif. + Freq. Sludge Removal	65%	93%
Flocculation + Clarif. + Freq. Sludge Removal	77%	96%

Experiments in sludge dewatering were made concurrently with the clarification investigation. Four standard makes of pilot plant vacuum filters, identical to their full-scale prototypes, were operated under varying conditions, one of these being the variable range of sludge characteristics resulting from a staggered intra-plant shut-down schedule for annual maintenance.

When intra-plant operations affected the filtration rate (lb of dried solids per sq ft per hour) it was found that the addition of hydrated lime to a prescribed alkalinity was the only requirement necessary to the maintenance of satisfactory rates. Actual Kodak Park operations now produce 90 cu yd of sludge, dried to 30 per cent solids, per day.

From 1949 until 1955 we continued to study the river and experiment with pilot plants designed to treat sample portions of the waste-water flow. From conclusions arrived at we planned the waste treatment plant in operation today. Its design was ap-

proved by the New York State Pollution Control Board, necessary funds were appropriated by the company, and construction was underway in the fall of 1955.

Current disposal and treatment operations start as the waste is conveyed from Kodak Park through two 48-in. tile-lined sewers to the first stage of treatment operations. Here, at a point 145 ft above the Genesee River, water-borne waste enters a storm by-pass chamber where normal flow is measured by a 4-ft-throat Parshall flume. In the storm water by-pass chamber there is a special, tainter-type, automatic by-pass gate, whose discharge is controlled by the water level in the Parshall flume. Power to operate this gate is developed by the hydraulic head on a pressure plate on the face of the gate. This gate was developed in Europe for use in irrigation channels and can control upstream or downstream levels within one inch.

How the Waste System Works

Following their flow through the Parshall flume, miscellaneous solids larger than one inch are removed by automatically-raked bar screens. Grit (e.g. cinders, sand) is then removed from the waste as it passes through an aer-degritter chamber which utilizes controlled velocities created by the introduction of air into the liquid for this purpose. On exiting the grit chamber near the bottom of the tank, the waste enters a 36-in. penstock, a specially-lined concrete pressure pipe, and descends 125 ft to a horizontal hydroelectric turbine, located in the main operations building at the foot of the river bank. This turbine uses the energy of the flow to generate 300 hp at the present rate of roughly 20,000,000 gal of flow per day. About two-thirds of the power generated is generally surplus and is run back to the main power plant.

The flow leaves the turbine through a draft tube into the tail-bay, and the waste is then conveyed by a 48-in. PVC plastic-lined pipe into a distribution manhole. From here it makes its way into the center columns of the two 130-ft diameter clariflocculators.

Within the clariflocculator tank there is an inner chamber 60 ft in diameter. In this flocculation chamber, made of amoron-coated plywood, the waste is gently stirred between sets of stationary and rotating panels. It then flows from the bottom of this inner chamber to the outer clarification area of the tank, over a stainless steel weir with 60-deg V-notches and thence into the effluent trough. At the designed rate of 26 mgd, detention time in these tanks is 2½ hours, with 15 minutes of this in the flocculation compartment. The two tanks are the largest ever constructed which incorporate both flocculation and clarification.

The clarified effluent is carried by a 42-in. PVC-lined pipe to a 48-in. outfall line in the Genesee River. This outfall line consists of nine 32-ft lengths of subaqueous concrete pipe which is also protected with a PVC lining; each of the last three lengths has six 8-in. diameter stainless steel outlets for dispersing the flow into the river. The outfall pipe is supported by 24 wood pile bents and, except for its outlets, is completely buried in the river bottom, 22 ft below the water surface. The eighteen 8-in. outlets rise to a level two feet higher than that of the outfall pipe.

Settled-out sludge, collected in the bottom of the clariflocculators, is withdrawn on planned intervals throughout the day by two triplex positive displacement pumps which discharge into two concrete holding tanks. Each of these pumps operates at a variable rate corresponding to the amount of sludge expected. Each holding tank has an approximate capacity of 50,000 gal. The accumulated sludge retained in the tanks is blended and made more filterable by a 50-hp mixer.

During the filtering hours, sludge is pumped from the holding tanks by three simplex positive displacement pumps located in the main operations building. Here the sludge filtration process is controlled automatically from a panel board located on the filter floor. Opposite this control panel are three 11-ft, 6-in. diameter by 14-ft long vacuum filters which dewater the sludge.

The vacuum is created by four 50-hp dry vacuum pumps, operating through a form, and a dry receiver, which provide flexibility in adjusting the amount of vacuum or air rate on the sludge pick-up or drying side of the filters. Because the pumps are of the dry type, a moisture trap has been installed on the building's roof and has a barometric leg to the basement. Sludge filtered averages 90 cu yd per day and maximum output to date has been about 270 cu yd.

Up to the present time the filtered sludge, as it was discharged from the filters in a cake form 30 per cent solids, was carried away by a conveyor directly into load-lugger bodies and hauled to a land fill. This method of disposal is ending, for a drier-kiln is being added to the treatment plant's facilities. The new kiln will reduce the volume of sludge substantially, leaving only an innocuous ash as the end of the waste process.

Site Problems

Eastman Kodak Co was fortunate in locating the Kodak Park works near the only accessible level area in the Genesee River gorge. But there remained several factors to consider in treatment plant construction: 1. the road to the site has a 15 per cent grade; 2. the site was formerly a city dump located on what was originally swamp land; and 3. the subsoil below the accumulated trash and ashes was shown to have poor bearing capacities as deep as 70 ft. Floor of the 130-ft diameter tank next to the river is 13 in. thick and was designed as a flat slab supported by 188 fifty-five-ton steel piles averaging 51.3 ft in length. The operations building is also supported by steel piles, with four 50-hp reciprocal vacuum pumps isolated from the building and separately supported. The turbine room tail-bay has also been isolated from the building and set on piles.

The waste consultant group, established in 1953, continues to aid Kodak Park departments in the study and solution of waste and recovery problems. The company feels that continued disposal and recovery studies will not only effectively aid pollution abatement of the Genesee River, but help Kodak fulfill its obligation to the area and to the resources which have made our own growth and prosperity possible. THE END

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If you are interested and meet these specifications, send a photograph and a résumé of your experience to the Editor, POWER ENGINEERING, 308 East James Street, Barrington, Ill.

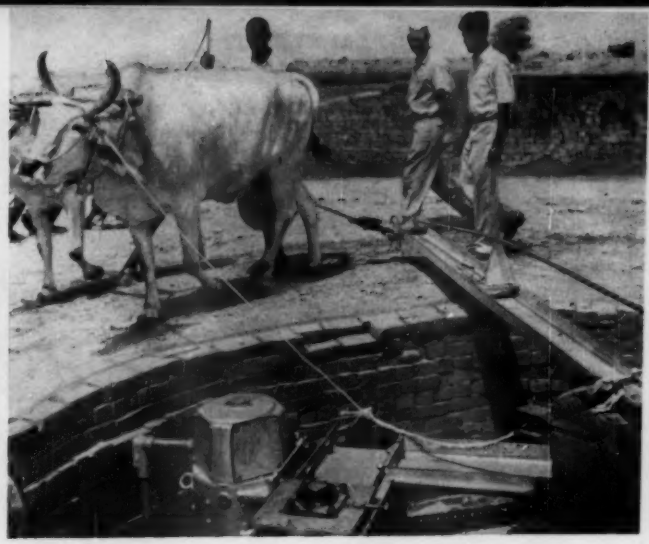

Fig. 1. Bullock-powered generator in operation. Generator at left is revolved by chain drive as bullocks pull draw bars

Kilowatts From Ox-Power

When Consultant C. Leigh Stevens visited India, he found them long on bullock-power, short on other kinds. Striking story of American ingenuity and a private Point-4 program is told here

IN THE TINY village of Khanpur, India, patient bullocks plod in a circle, powering a device of American design which one day may revolutionize the life of rural India. This device, making modern use of ox-power, has tripled the irrigation rate of one of Khanpur's wells and has given the village its first electricity.

Khanpur's new affluence was made possible through the coöperation of the Tennessee Gas Transmission Co and a number of other American firms and individuals interested in helping lift India to a higher level of agricultural and industrial methods.

Two Tennessee Gas engineers, Tracy S. Park, Jr and J. L. Morrison, collaborated in the design of the revolutionary mechanism, Fig. 1, which permits operation of a commercial water pump and electric generator by bullock power.

Unit consists of the pump and generator, a vertical drive shaft, and the driving mechanism. Unique feature is the driving mechanism, which consists of two draw bars and a series of chains and sprockets, Fig. 3.

Harnessed to the draw bars, teams of bullocks walk in a circle, thereby revolving the chains and sprockets. In the pump-driving mechanism, two stages of sprockets are used. First stage converts the 2 rpm of the bullocks to 20 rpm; second stage converts this into the 150 rpm needed to operate the pump.

As the pumping unit was being developed, it became apparent that the same driving mechanism could be used for a power generator. A 4.5-kw d-c generator that produces a constant 125 v, even though the bullocks' speed may not be constant, was contributed by General Electric Co.

For operating the generator, a further increase in speed is achieved by engaging a clutch and bringing into action a third-stage series of chains, thereby converting the bullocks' 2 rpm to 1320 rpm, the speed of the generator.

Where bullocks walk down well-side ramps, lifting huge buckets by means of ropes and pulleys, using two teams of four bullocks each, it is possible to draw approximately 95 gpm of water by this method.

On the other hand, with six bullocks powering the new pump mechanism, a capacity of approximately 300 gpm is possible. Well to which this first installation was fitted formerly irrigated about seven acres. With the installation of a 540,000-gal reservoir nearby, it is estimated that the new pumping mechanism will irrigate as much as 70 acres. THE END

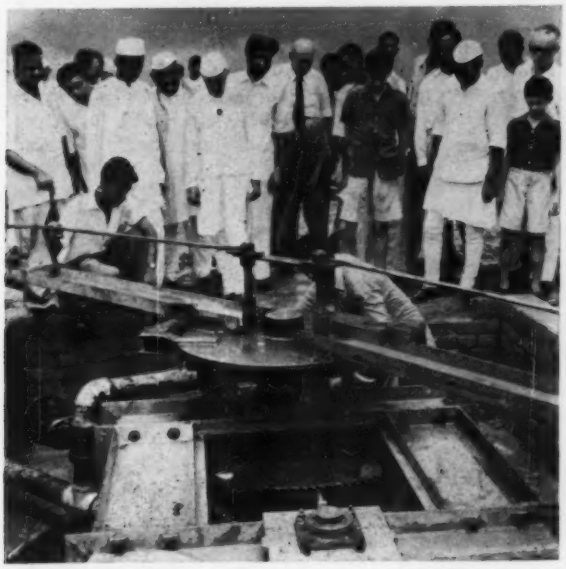

Fig. 2. India's Nehru, center, and Management Consultant Stevens at Nehru's left are shown inspecting the installation

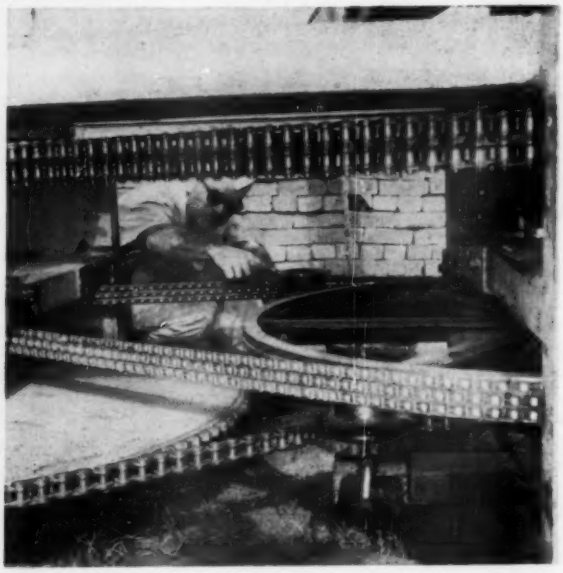

Fig. 3. Tracy Park, Jr points to system which converts ox-power into higher speeds needed for pumping and generation

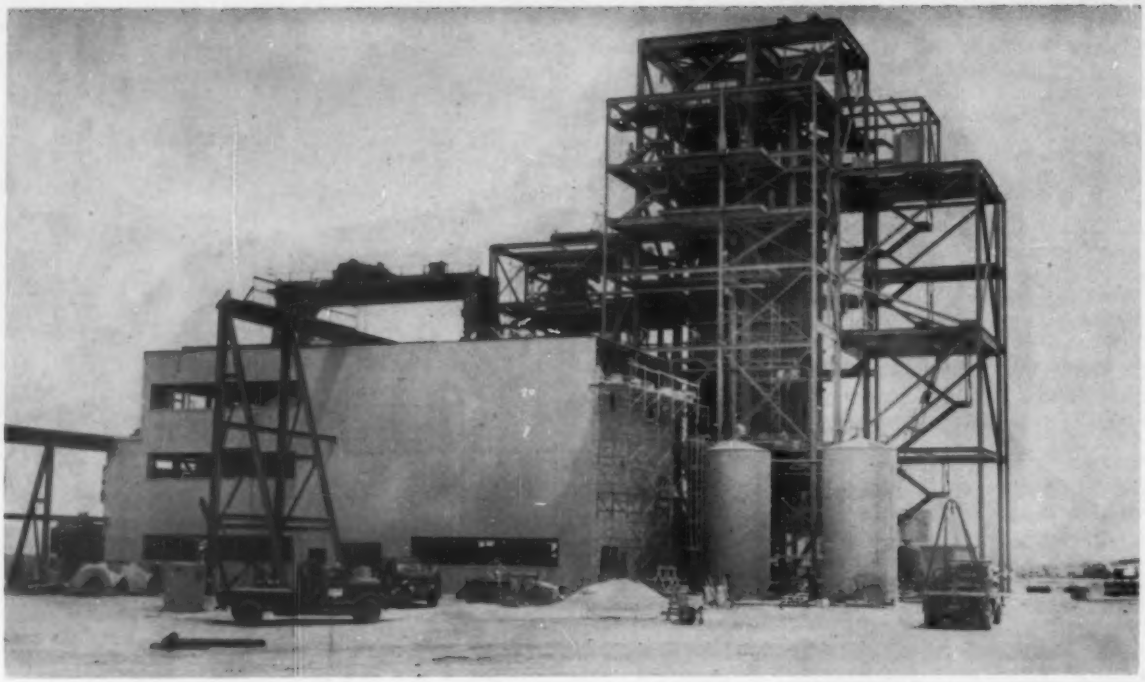

Fig. 1. New Reeves Station of Public Service Co of New Mexico. Stud welding was used for boiler casing and building siding

Stud Welding Cuts Construction Costs For New Mexico Public Service

Technique developed for building ships in a hurry during World War II, stud welding has many applications in the power field. Use in a novel boiler insulation method by this utility company resulted in substantial savings and an eye-catching finished job

Another Power Tool

SUBSTANTIAL SAVINGS in over-all construction cost, and several corollary benefits, were realized when end-welded studs were used recently for the first time to secure insulation and lagging for a high-temperature, pressurized power plant boiler.

At the new Reeves Station, being constructed near Albuquerque for the Public Service Co of New Mexico, Nelson stainless steel Setlok studs were first end-welded in organized patterns to the pressure casing of the boiler. Several studs were welded per minute with the lightweight Nelson stud welding gun. Two 2-in. thick layers of magnesia block insulation were fitted over the studs and made snug against the pressure casing. Ribbed, embossed aluminum lagging, 0.032 in. thick, was then impaled over the studs.

This idea not only brought important economies during construction, but it is also expected to cut maintenance costs during the life of the plant. It was originally conceived by Ralph A. Withrow, engineer for the Stearns-Roger Mfg Co, engineers and constructors for the project. Stearns-Roger, in coöperation with Public Service of New Mexico, worked out the original insulation and lagging concept and carried on the research preceding the installation.

Another out-of-the-ordinary feature at Reeves Station is colored aluminum insulated sandwich wall, which saved approximately 15 per cent over conventional sandwich walls. Assembled on the job, it was used for both the administration building and the main power plant building. Additional savings were realized because the aluminum needed no paint.

Stainless steel Setlok studs, end-welded in the field to building girts, also secured the curtain wall. It is comprised of an interior sheet of 0.032-in. corrugated aluminum; insulation of 1-in. fiberglass; exterior siding, with alodine green finish, of 0.032-in. ribbed, embossed aluminum.

To help hold the boiler insulation in place, 1-in. wide, light gauge aluminum strips were stretched over the magnesia blocks and impaled on the studs, then secured with speed clips. All buck stays were covered with aluminum wrappers, also impaled on studs, which then served as flashing. When the lagging was in place, Setlok aluminum caps were applied to the studs.

Another advantage of this installation was that no hand-welding, wiring, or drilling and tapping was necessary to secure the boiler insulation. Aluminum boiler lagging does not require painting, as does conventional sheet metal lagging.

Moreover, significant maintenance

economies are expected during the life of the boiler, largely because the insulation and lagging can be easily removed from the pressure casing to facilitate repair and can be reinstalled later with approximately 100 per cent salvage value. No special tools are necessary, and since the aluminum lagging is light in weight, small maintenance crews can perform the task.

Another significant stud welding application on this project was the use of ⅞-in. diameter threaded studs which secure the rails for a gantry crane located on top of the main power plant building. These studs were end-welded to structural steel. Rails rest on the steel and are fastened by clips that fit over the rail base flanges. Clips are fitted over the studs and are held in place by standard machine nuts. THE END

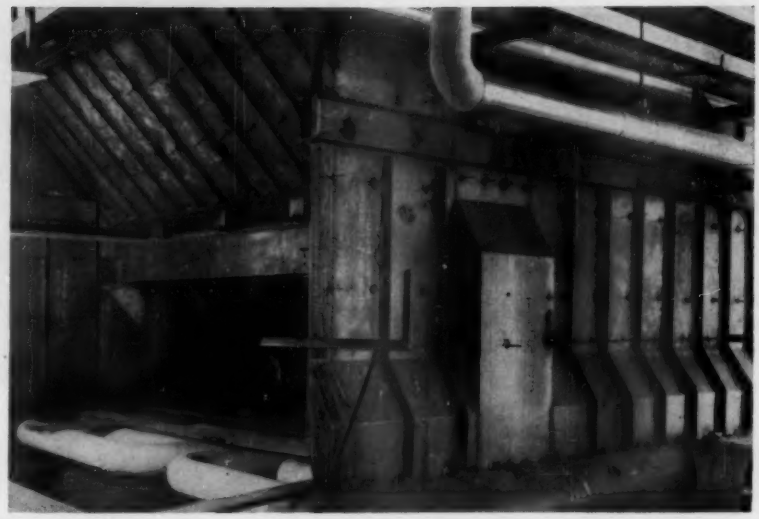

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Fig. 2. **End-welded studs,** shown above on pressure casing of the boiler, made it possible to install insulation and lagging with substantial savings. Magnesia block insulation and aluminum lagging were impaled over studs and were then topped off with the special caps

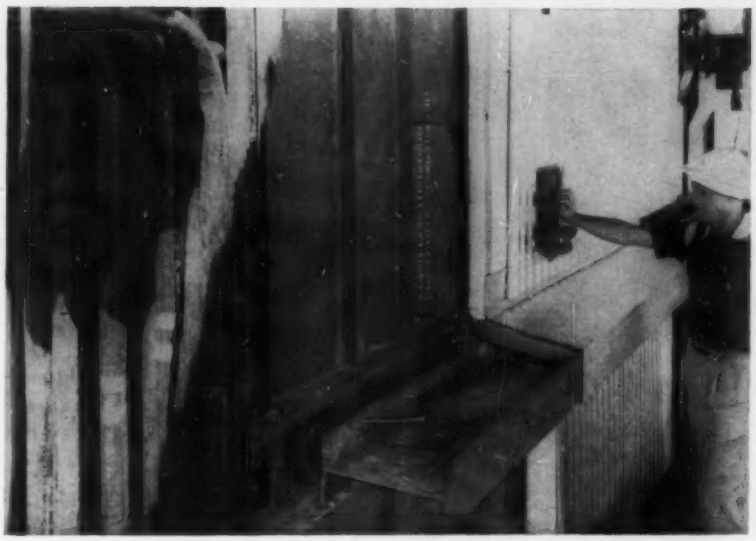


Fig. 3. **Various steps** in new method are shown here. At left are water wall tubes. After casing is seal-welded and tested, Nelson stainless steel Setlok studs, two of which may be seen here, are end-welded to casing. Magnesia block and lagging are then positioned

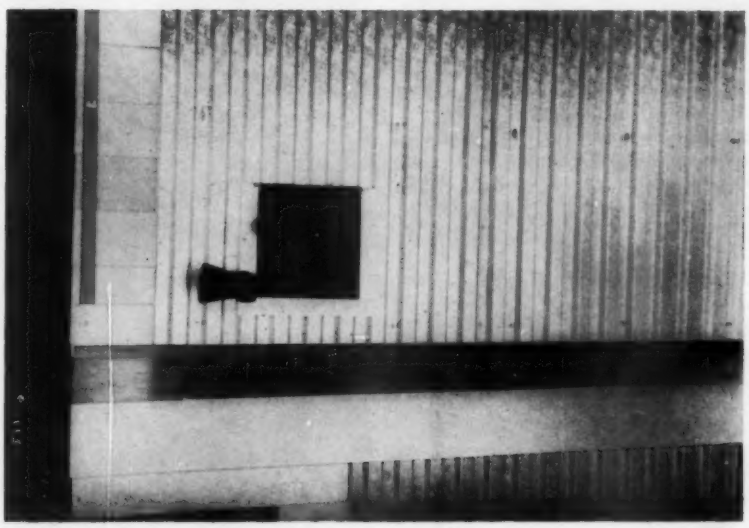
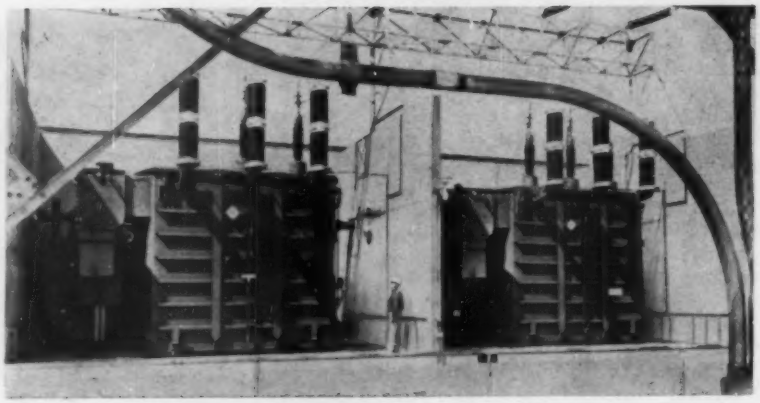
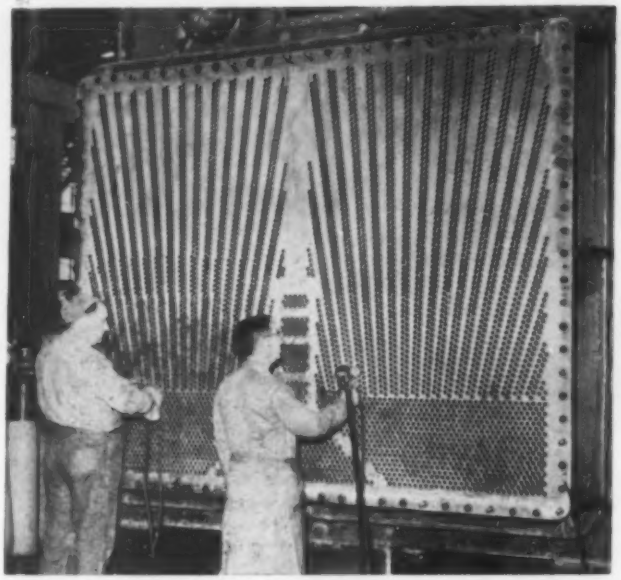


Fig. 4. **Pleasing appearance** resulting from new method is shown in this picture. Ribbed, embossed aluminum lagging and magnesia block insulation not only were installed more economically through use of studs, but they are also easily removable for maintenance

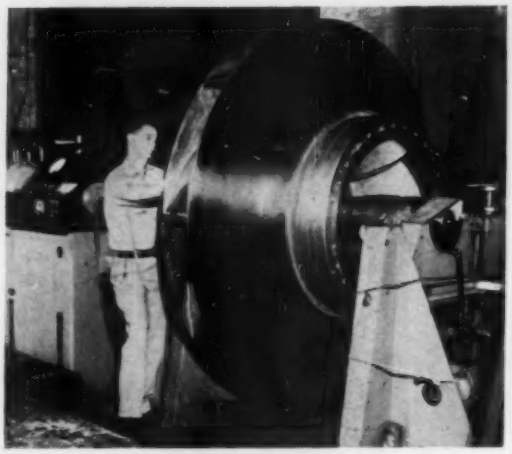


Dual-cooled Allis-Chalmers transformers are used at Wisconsin Electric Power Co substation. If one unit is shut down, other will carry required load by utilizing the cooling system of idle unit. Each is rated at 90,000 kva and is cooled by forced oil, circulating through the oil-to-air heat exchanger

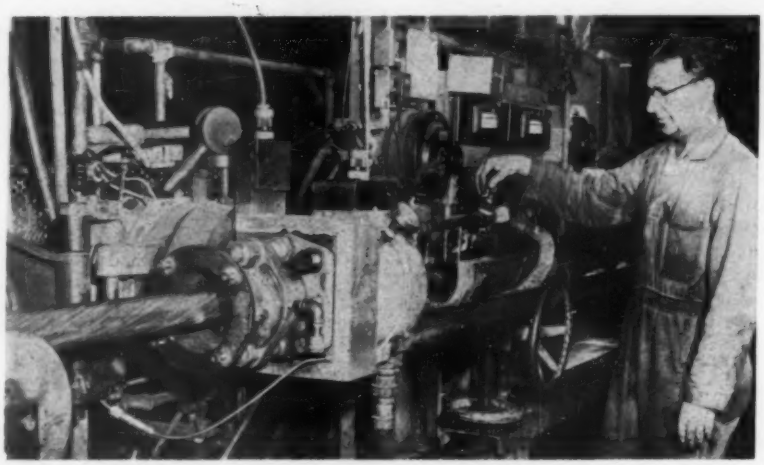
POWER ENGINEERING'S



70/30 cupro-nickel, made by Revere Copper and Brass, was used for tube sheets and tubes in condensers for *N. S. Savannah*. Condensate purity measured in parts per billion is required. A new, lightweight automatic welding gun was used in welding tubes in sheet. Small mandrel centers the gun



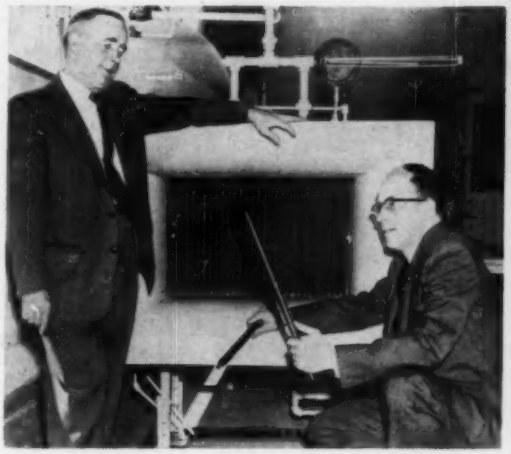
10,000-lb stainless steel impeller, last of seven shipped recently by Worthington Corp to the Metropolitan Water District of Southern California for installation in vertical volute centrifugal pumps. These are said to be the largest stainless steel impellers



Giant-sized power-bus cable is made up of 271 individual strands, weighs 15½ lb per ft. Made by GE, the 5-million circular-mil copper conductor has a $^{13}/_{64}$-in. wall of Flamenol thermoplastic insulation. It will be used as part of a 1,000,000-amp pulse discharge system for space research

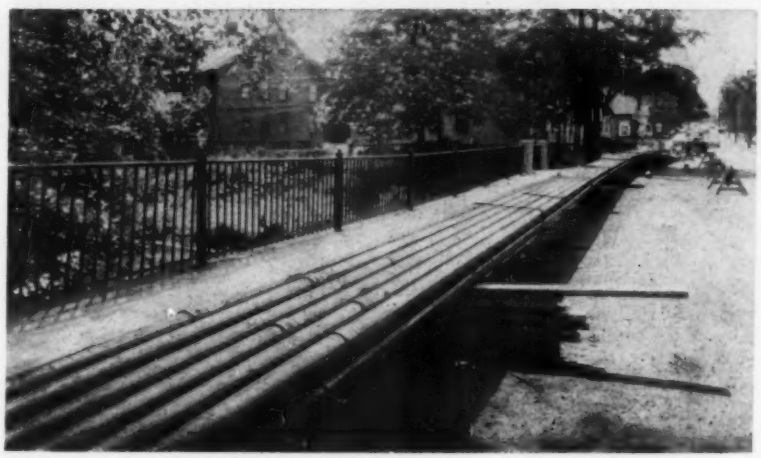
Ticket for transformer? No, Floyd County (Ga) police are simply preparing to escort trailer truck carrying GE 2000-kva load center transformer for a unique series of road tests. Idea of test was to recreate condition of a transformer as it is received by customer via this type of transportation

NEWS REEL



20 years of heat transfer research at the University of Michigan, sponsored by Wolverine Tube, is being celebrated this year. J. S. Rodgers (left) of Wolverine and Prof. E. H. Young of the University here go over some of the devices used in finned tube testing

Testing reactor with a rating of more than 300,000 kva has been installed at Westinghouse plant to study thermal and electrical characteristics of modern high-capacity turbine generators. Large coils of reactor consist of three elements, each 14 ft high. Can test units rated over 400,000 kva



Banks of conduit waiting to be embedded in concrete sidewalk of new bridge in Hartford, Conn. Engineered by Hartford Electric Light Co, system uses Byers 4-D wrought iron conduit for corrosion resistance, will carry power lines to industrial plants in West Hartford. Link across bridge is 3200 ft

Here's How Big Electrical Projects Are Organized

Today's big building projects involve a lot of electrical facilities. In addition to power and lighting, many other services must be included. All these require careful planning and execution by the electrical contractor. Here's how all this is accomplished by one firm

By FRANK W. MICHAL*

MAJORITY OF TODAY'S electrical contracting organizations are geared to transact business along sound, modern concepts. They are led by top-flight executives, supported by a hard-hitting team of professional men with a wealth of experience in both theoretical and practical aspects of all phases of business. And, their organizational structure and management practices can be stacked next to any progressive business of today.

It is fortunate that this is true, because the ratio of electrical to total construction cost of new facilities is approaching a new high. But, while owners are budgeting more money for their electrical facilities, they are getting more for their *electrical dollar* through contractors' good administration, cost-cutting installation techniques, better job coördination, good material prices, and increasingly better skilled labor.

Why the Rise in Costs?

Why are electrical costs going up? One reason is simply that standards for comfort conditions are at a new peak and are accepted as necessary to conduct of business. Demands for complete air-conditioning (temperature and humidity), and increased lighting levels, result in more electrical services.

Another reason is that owners are becoming more conscious of the *importance* of their electrical systems. They are no longer following the old short-sighted approach of squeezing the electrical budget to a ridiculous minimum, in exchange for other construction details.

Owners are not only asking for, but demanding of their architect-engineers, electrical designs to provide such features as — (a) more available power for immediate use; (b) more reserve capacity for tomorrow's use, plus better reliability to guard against costly shutdowns; (c) better flexibility to suit changing requirements; (d) better quality of materials to keep replacement cost down; and (e) more practical distribution systems.

This is to keep operational and maintenance costs down to a minimum by proper use of disconnecting devices, sensible circuit arrangements, and others. All of these naturally increase initial cost but pay off in lower cost over the life expectancy of the building.

Getting to Know the Job

In a typical large electrical project, just what are the steps to be taken in preparing a complete and accurate construction bid? An excellent example is that of the new Chicago Coliseum project, officially known as the Exposition Center. Our company was the successful electrical bidder on this huge project, so we will use it as an actual case history to illustrate just how a contractor goes about bidding and planning his phase of the project.

This was a king-size project in itself. And we spent a lot of time studying the plans and "specs" before we started any estimating. It made a lot of sense to concentrate on this phase because it gave us a visual picture of the project. We studied type of building construction, searching for unusual features and special building conditions — noting such items as ceiling heights, slab thicknesses, special ceilings, etc. We also reviewed the mechanical drawings in relation to the electrical installation.

In addition, we thoroughly familiarized ourselves with the scope of electrical work, as described in both the general and electrical and mechanical sections of the specifications. Also, we tied down such responsibilities as trenching and backfill, concrete work, cutting and patching, painting exposed conduits, temporary power, and others. Once the over-all job was well-defined in our minds, we were ready to begin putting a price tag on the job.

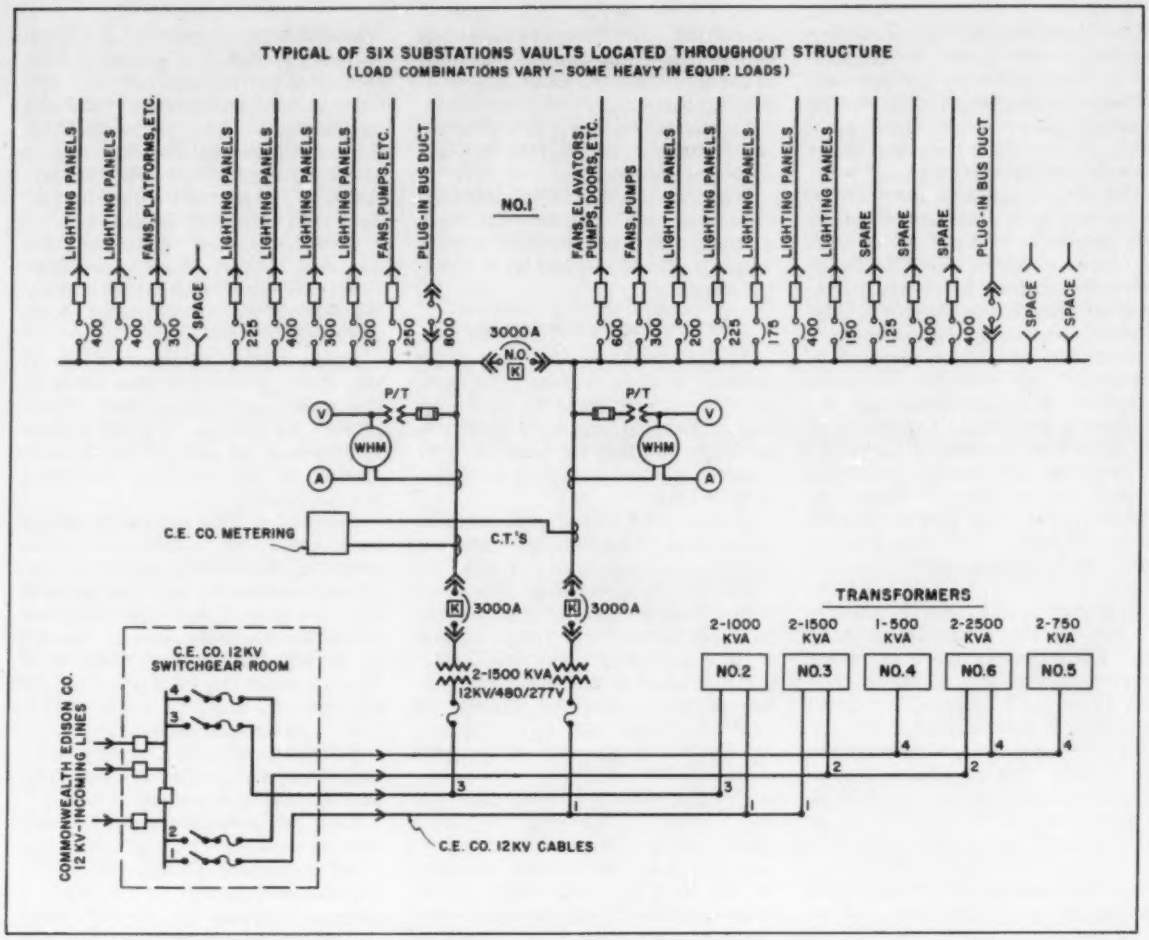
Preparing the Estimate

Because of the scope and complexity of the estimating job and the relatively short time allotted to prepare the bid, the task of estimating was assigned to six estimators. Also, to expedite the procedure, the job was broken down into ten major systems. But these were not selected without careful consideration.

They were logical divisions which permitted: — 1. Six estimators to

Final review of job estimate is made by staff members of Fischbach, Moore and Morrissey, Inc. Left to right: RON DUDEK (Project Engineer), FRANK MICHAL (Admin. Asst.) and RAY MEEHAN (Vice-President)

*Fischbach, Moore and Morrissey, Inc; Midwest Division of Fischbach and Moore, Inc



Drawing of Schematic diagram of electrical feeders included in contract for Chicago Exposition Center. Note three incoming 12 kv lines, which feed six separate building substations; also detail diagram of No. 1 Sub. Total transformer capacity is 15,000 kw

work simultaneously; 2. checking and evaluating final costs for definite work categories; and, 3. producing the final estimate in a form which would permit purchasing of components, without recapping hundreds of miscellaneous sheets.

Here are the ten sections:

1. *Lighting*
   Feeders (conduit and cable)
   Panels and control equipment
   Branch-circuit wiring
   Fixtures
2. *Power Distribution*
   Feeders (conduit and cable)
   Bus duct
   Transformer vaults and Eqpt.
   Motor Control Centers
   Emergency generators
   Power Centers
3. *Underground Distribution*
   Primary ducts and cable
   Secondary ducts and cable
   Manholes and vaults
4. *Lightning Protection*
5. *Grounding*
6. *Theatre & Lecture Rooms*
   Special equipment
   Emergency Lighting
7. *Fire Alarm System*
8. *PAX Telephone System*
9. *IBM System*
10. *Sound & Video System*

First, and basic, step in preparing an accurate estimate is that of material analysis. A count was made of all outlets, fixtures, and equipment; and, a measurement was made of all branch-circuit runs, feeders, service, etc. Every item was taken off — from lockwashers to switchgear.

To assist us in making a complete take-off as quickly as possible, devices such as rotometers, tabulators, scales, and tapes were used. Our take-off was so complete that, if necessary, the estimate could be completed without further reference to the drawings.

We finished with approximately 300 detail take-off sheets and over 100 summary pricing sheets, listing the accumulation of take-off quantities of electrical materials required for the entire installation. There were some 2000 items of material.

Costing labor units: According to the Natl. Elec. Contr. Assn, *A labor unit is a cost data figure indicating the labor cost for putting in place a given item of material or performing a given labor operation.* And, picking the proper labor unit isn't easy. It takes a good estimator to come up with an intelligent analysis of the labor involved and not use labor units without adjusting them to suit conditions.

For example, type of building construction, height of installation above normal area, weight of material and equipment, length of runs, number of parallel runs, and crawl-space conditions all affect a standard labor unit. Also, labor units are expressed in *man-hours per unit*, or units.

It's more practical to use this system than *dollar value* units, as it permits conversion and adjustment by one simple multiplication of wage rates to obtain total labor costs. We used our Manual of NECA Basic

Labor Units to assist in compiling the proper labor figure. In addition, we referred constantly to our own statistical accumulation of labor units, constantly kept up to date, as a result of cost data from thousands of completed installations.

This is a tough assignment, even for the *pros* in the business! We dealt with hundreds of suppliers, of both standard and special electrical equipment and devices, to obtain quotations on materials as specified. Quotations poured in by the hundreds.

Each one had to be checked to determine: (a) whether the items complied with specifications; (b) whether quantities, and inclusion of all items, were specified correctly; (c) whether the quoted price was limited for a specified time; (d) whether prices were firm for the life of the job; and, (e) whether delivery could be obtained when required at the jobsite.

It sounds simple. Yet in practice it's just not this clean-cut an operation. For example, there are times when suppliers will withhold their best price until practically bidding time, which means a constant juggling of figures. Also, some suppliers will submit lump-sum quotations of certain groups of items, and include in their proposal some items which will not meet the specification. This is to make an attractive package deal, yet provide no cost breakdown of the items.

Material Extensions

Fortunately, we didn't run into such situations in pricing the material for the project. If we had, it would have been necessary to compel the supplier to provide a breakdown — in order to evaluate the cost of the acceptable components against other quotations for the same equipment. We obtained at least three quotations for each item.

Once satisfied that our prices reflected equipment as specified, we prepared our material price data comparison sheets, selected the lowest acceptable prices, and used them as a basis in preparing our material costs.

Experience has taught us that mistakes in extensions are easy to make, because of unit conversions. For example, certain materials (boxes, covers, fittings) are priced on a per-hundred basis; insulated wire and cable in 1000 feet; bare wire in 100 pounds; and certain equipment per item.

Labor units could be specified in manhours per 100 pieces, or 1000 pieces; and, for certain items, *manhours per unit length*. Electric calculators are used extensively in making extensions, and every extension is double-checked by another estimator or accountant. (A little time-consuming, particularly when you're racing against a deadline, but well worth it.) Initials of the checker are put on estimate sheets.

With the use of adding machines, extensions are totalled for each summary sheet — another process which is double-checked by a different estimator.

Preparing the Summary

So far, we have done the major portion of work necessary to come up with a *prime* cost. We have total cost of material, and total manhours of labor. Multiplying wage rate by number of manhours gives total productive labor.

But, over-all cost of a job includes other items which have to be paid out by the contractor to complete his work. For instance, *Supervision and Non-Productive Labor:* No simple rule to apply here; it will vary from job to job, depending upon scope, complexity, location, and size and number of electricians on project. In general, it will run approximately ten to fifteen per cent of the productive labor cost.

Travel Time and Expense also will vary from job to job, depending mostly on location and labor agreements. It's a good practice, however, to list such cost separately, rather than combine it into the total manhours of productive labor. This is so it will not introduce an error in final progressive job-cost analysis.

Sometimes, however, when travel-time hours are in addition to the normal eight-hour work day, forty-hour work week (under the provision of Wage Agreements), personnel have to be paid at an overtime rate — an item not to be overlooked.

Insurance and Payroll Taxes — This is proportional to amount of total payroll but will vary for different areas. In general, this usually amounts to 10 to 14 per cent in our area. These percentages are made up of such items as unemployment insurance, social security, workmen's compensation insurance, public liability insurance, association dues, and welfare assessments.

Job Expenses — Included here are such items as tools, equipment, shanties, field office, warehouse, freight and delivery, telephone, office supplies, inspection fees, drawings, and payroll for project manager, Superintendent, Engineer and Timekeepers.

Bonds — Required mostly by public and institutional projects, where public funds are used to finance construction. For those not familiar with such bonds, here's the protection offered to the owner in a typical performance bond: It guarantees the successful performance of the contract in accordance with plans and specifications. Also, it indemnifies the owner from any liability and/or loss, resulting to the owner from any failure of the contractor to fully perform each and all of his duties.

However, after contracts are awarded, the performance bond may be waived, with resultant savings (of the cost of the bond) passed on to the owner.

Prime Cost — Addition of all of the above items provides us with the basic cost (prime cost) of the project. In general, it is all monies that have to be paid out by the contractor, as *job costs*, less overhead and fee (profit).

Overhead — This is a factor not to be guessed, or overlooked, when preparing the over-all cost of the job. (Many contractors don't know what their overhead is, and therefore wonder where the profits are, at the end of the year.) It can vary from 10 to 25 per cent of the total prime cost of the project.

It includes such items as:

Salaries of officers

Salaries and wages of office help and non-productive labor

Cost of occupancy (rent, heat, telephone, etc)

Office expenses (postage, stationery, supplies, etc)

Legal expenses

Auditing expenses

Charge-offs (bad debts, depreciation)

Insurance (officers and personnel), and hospitalization

Plus all other expenses required to do business, and not directly applied to the job costs.

Profit—The Unknown Quantity

The final *mark-up* is always put on by an officer of the company, after careful check of the estimate, and often readjustment in the figures of the estimators. It is determined after careful analysis of the competitive situation, job potential (extras), size of contract, etc.

In a large project, it takes only a small error in judgment to either overbid the project (and lose it), or underbid the project and throw profit down the drain.

There's no simple formula for estimating. It takes keen business management and a lot of expert analysis. For example, our records show we spent 840 hours estimating the Exhibition Center project and obtaining special prices on materials and equipment — from the manufacturer's level, down through the jobbing houses.

All big electrical projects involve a certain amount of temporary light and power, to accommodate the other building trades which are working on the job.

Also, the electrical contractor is expected to maintain all electrical equipment used during the construction cycle. Therefore, these two items must be included in the total job estimate.

Reviewing all of the factors which make up a complete electrical job estimate, we find a thorough listing of these thirteen items, shown below:

Materials
Materials sales taxes
Labor — Direct
Labor — Indirect
Travel time and expense
Insurance
Payroll taxes
Job expenses
Bond (if required)
Overhead
Profit
Temporary light and power
Temporary maintenance

Editor's Note: A subsequent article by the same author will explain how his company successfully bid the electrical work on the Chicago Exposition Center, and how they organized the job.

For the uninitiated, this next article will be a revelation; it will tell of the hundreds of details which must be followed in the successful prosecution of a big job.

This type of a project is one of the best examples of power engineering in action. Don't miss it. THE END

For Cold Storage, the Floor Must Be Right

By C. T. BAKER *

AN ADDITION was made to the existing facilities of a cold storage plant. The carrying temperature required by the produce company renting the new storage was 35 to 36 F.

After some 15 years of operation at this condition, the produce company wanted to store quick-frozen foods in this room. In order to provide the lower temperature required (15 to 20 degrees below zero) additional cooling coils were installed.

Construction of the plant addition is shown in Fig. 1. Since the temperatures originally carried were well above the freezing point of water, the four inches of sheet cork insulation on the floors, walls and ceilings were adequate.

However, when temperatures are lowered to zero and below, a much greater thickness of insulation is required to hold heat leakage losses within acceptable limits, and also to prevent ground freezing when the floor of a cold storage room is placed directly on the ground. Also, it is generally necessary to provide underfloor heating to prevent ground freezing, since no amount of insulation will prevent ice formation where wet soil conditions prevail or where ground waters stand within a short distance of grade line.

After a few years of operation at sub-zero temperatures, the ground below the floor of this added storage room had frozen to a depth of several inches. In time, the forces produced by the freezing action below grade pushed the floor upward in several places, causing damage both to the concrete and to the insulation.

Further, the 12 by 12-in. column located in the center of the room was forced upward, causing considerable damage to the roof structure as a whole. Rainwater and moisture condensed from the air, entering the insulation on the roof deck, damaged the roof assembly even more, as freezing progressed.

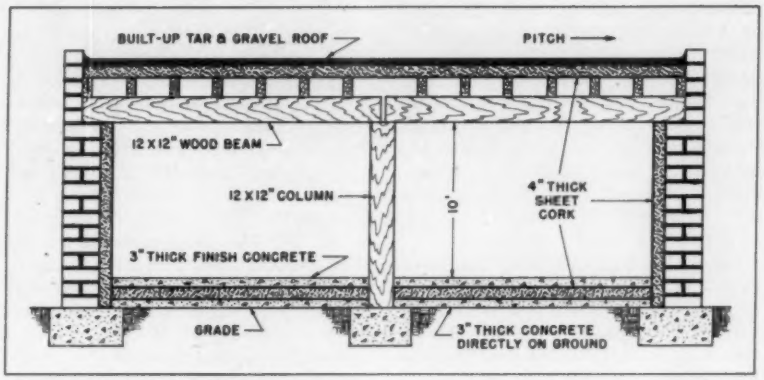


Fig. 1. Floor of new addition kept to the 4-in. insulation. It wasn't enough

Cost of tunneling beneath the floor to provide warm air circulation for ice meltage and to prevent further freezing was considerable, since the existing ice formation made excavation operations quite difficult. In addition, provision had to be made to drain away from the building the water resulting from ice meltage.

In time, the supporting column returned to original position, after which the floor was repaired and the damaged insulation replaced. The room is no longer used for minus zero storage.

Figure 2 shows a practical layout of underfloor venting used by the writer to prevent frost heave in a large storage room that was designed for room temperature of minus zero.

In this layout, 8-in. terra cotta tiles are placed 8 ft o. c. Ends of the tile are set above ground level to prevent the entrance of rain water.

Figure 3 shows the correct method of installing floor drains in refrigerated rooms that are carried at temperatures above freezing. In many cases, atmospheric vent heating is not practical as a means of protection against frost heave. Many installations of low temperature rooms, where the floors are placed directly on the ground, pump heated oil or other heated solutions to keep the ground well above freezing.

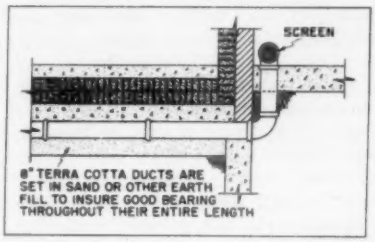


Fig. 2. Vent will prevent frost heave

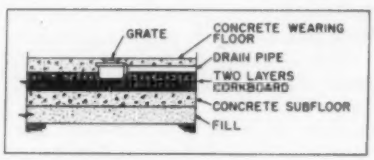


Fig. 3. Floor drains for above 32 F

* Consulting Engineer

How We Train Supervisors

Company-wide supervisory training at Commonwealth Edison is now 10 years old. A concentrated program of coaching in four major areas of information is given to provide help to the newly appointed supervisor in meeting his new responsibilities efficiently

By GEORGE E. RODMAN *

WHAT is Mr. New Supervisor looking for as he faces his new responsibilities?

Well, obviously he needs new knowledge, new skills, new attitudes. He needs to know about company organization, policy, and financial problems. He needs to appreciate what is involved in skills in instructing, planning work, interviewing, communicating. He needs to understand and nurture proper attitudes toward management, employees, toward other departments in the company, toward the union, stockholders, customers.

Where is he to get all this?

In answering this question in a practical way at Commonwealth Edison, we have seen that the supervisor needs something over and above the instruction he will get in the natural course of events from his boss at the departmental level. And, since the principles and skills of good supervision are the same for any job situation, an over-all program which exposes all supervisors to these principles does much to raise the level of supervisory excellence generally.

So our program of training in basic supervision draws in all new supervisors — from generating stations, accounting, purchasing, etc. — and supplements the person-to-person training that goes on continually within the departments. We base this program on four major areas of information, and run it for 13 full days of meetings, held once a week.

The four areas covered are: 1. company organization, activities and policy; 2. the union contract; 3. human relations in supervision; and 4. effective supervisory principles and skills. We spend about 25 hours on the first area, eight hours on the second, 25 hours on the third, and 25 hours on the fourth.

Company organization and policy is presented through a group of some 25 talks, each aimed at a different facet of the subject. Eight sessions are given over to the union contract. There are seven talks on aspects of human relations in supervision, and a group of 12 talks comprises the content of the fourth area — effective supervisory principles and skills.

Who gives these talks and how are the sessions conducted? This brings up an extremely important point.

We consider that the success of this basic supervision program rests squarely on the enthusiasm and coöperation with which top and middle management have supported it. Some 50 individuals make up the leaders and speakers for these training conferences, and with the exception of two or three, all of these leaders are from within the company. Nearly all the members of the top management team are included, and the manager and division vice-presidential levels contribute their full share of teaching and speaking talent.

We have made the most of this in-company approach to training leaders. Human nature being what it is, there is great value in giving the new supervisor the opportunity to sit down and talk things over with the top brass — and this is essentially what these training sessions do, especially the ones devoted to company organization and policy.

Presentation of the subject matter is followed by multiple table discussions by the table groups of some nine persons each. The leader at each table stimulates discussion to check their understanding of what they have heard, and to list any questions they might wish to ask the speaker. These questions are then directed to the speaker by the discussion leaders, and very frank questions they often are. At the next meeting of the total group, the supervisors will be mixed into new round table groups, and new leaders will be appointed.

As a side note on meeting techniques, it should be explained that when the subjects of job instruction training and job relations training are presented, the group is divided into several sub-groups with a trained instructor in charge of each. Each of these groups has three 2¼ hour meetings. For job planning, too, we use the sub-group system. The general subject is introduced by a division vice-president, followed, in sub-groups, by application of the principles of job planning to typical jobs.

Here's the schedule for a typical day of training under this program of basic supervision:

Program in Basic Supervision

1958—Group 17

Meeting #2, Tuesday, March 4, 1958

Time	Subject
8:30–10:15	Supervisor's Leadership Situation
10:15–10:30	Recess
10:30–11:00	Supervisory Problem Survey
11:00–12:00	The Bargaining Agreement #1
12:00–12:30	Recess
12:30– 2:00	Luncheon — Looking Ahead
2:00– 2:15	Recess
2:15– 3:15	Communications
3:15– 4:30	The Supervisor and Better Ways

20 Basic Responsibilities of Supervisors

1. Setting a good example and exercising self-control.
2. Encouraging employee interest in his job and its relationship to the company's business.
3. Developing group discipline, confidence and loyalty: creating the "feeling of belonging."
4. Developing an understanding of each employee and his problems.
5. Dealing fairly and impartially.
6. Evaluating employees' performance and informing them concerning their progress, giving due credit for good work.
7. Studying and developing abilities of employees.
8. Guiding and counseling employees.
9. Coöperating with others in the organization.
10. Maintaining an adequate knowledge of work, company policies, and union contract.
11. Foreseeing and eliminating possible causes of grievances.
12. Assigning the right man to the right job.
13. Organizing, planning, and coördinating work.
14. Issuing clear, concise, and complete constructions.
15. Maintaining efficiency of force.
16. Studying, inspecting, and determining suitability of tools, machinery, and equipment.
17. Recommending changes in employee status.
18. Maintaining good and safe working conditions, and encouraging a safety-conscious attitude.
19. Transmitting information accurately and promptly.
20. Maintaining adequate records.

In 1945, company appointed a committee to study the supervisory job and find common responsibilities of all supervision. These 20 points resulted

*Supervisor, Education and Training, Commonwealth Edison Co

Fig. 1. At lunch session during day-long meeting, supervisors hear talk from a top officer, afterwards have opportunity to ask questions. Here vice-president Gordon R. Corey explains aspects of the company's financial structure

Fig. 2. Customer relations is a vitally important subject and is assigned to a division vice-president for handling. Above (r) R. S. Peterson addresses supervisors, establishes foundation for right understanding of this part of the job

Fig. 3. For sessions on job instruction training and job relations training, the group is broken up into sub-groups, each with its own instructor. These JIT and JRT conferences are rated by supervisors as having high degree of helpfulness

Now, for more detail on what is presented in the four categories of the program:

Here are a few of the subjects included under Company Organization, Activities and Policy: the supervisor and employee health, power production activities, the supervisor and cost control, rates, public relations, the budget, organization policy and our 1959 organization, activities of research and development staff.

An understanding of collective bargaining and interpretation of company contracts with the unions are especially important to first-line supervisors in a company such as Commonwealth Edison. So the eight one-hour sessions devoted to the union contracts clarify the subject — covering the history and reasoning behind general provisions in the contracts, specific provisions of current agreements, and problems of interpretation.

Under Human Relations in Supervision, talks are given on principles of motivating employees, supervising employees with unsatisfactory attitudes, job relations training, control of absenteeism, supervisor's leadership situation, and types of supervisors.

The 25 hours given to studying effective supervisory principles and skills are filled with such themes as job planning and coördinating, job instruction training, communicating, the supervisor and better ways, coaching, listening, management principles.

Talks by Officers

The subjects presented by officers of the company include: historical objectives; looking ahead; what top management is looking for in leaders; organization policy and the 1959 organization; management principles; financial structure; challenges and problems in the financial area; activities of purchasing, fuel, real estate and tax departments; public relations.

We took a supervisory problem survey to find out which subjects loom up as the most difficult problems for supervisors. On the basis of what we found out from this survey, division vice-presidents have been presenting the following topics to the training groups: problem of communications; principles of motivating employees; supervising employees with unsatisfactory attitudes; planning the job.

High on the list of the supervisors' own favorites are the sessions given over to job relations training and to job instruction training.

A revision of the Training-Within-Industry wartime program, the job relations training presents a simple four-step approach to "people" problems aimed at developing and maintaining effective coöperation. The steps are: 1. get the facts; 2. weigh and decide; 3. take action; 4. check results.

Foundations for good relations, differences in people, and causes of human relations problems are reviewed and discussed at some length. Then each member of the training

Why This Article

Effective training techniques continue to be of paramount interest and importance to power plant management. This article, dealing with a very special problem in the total training picture, climaxes the training series which has been appearing in these pages over the past 18 months.

group is asked to select a human relations problem, preferably from his own experience, to present and discuss with the group. The instructor then gets the supervisor to re-tell the case based upon the four steps.

The popularity of this job relations training is no doubt due to the fact that a simple, systematic approach to human relations problems is a real help in the solving of such problems as they come along.

Job instruction training (also a revision of the Training-Within-Industry wartime program) has to do with one of the most important responsibilities of a supervisor — that of instructing. Therefore, the specifics of an effective way of instructing are presented and practiced in this program. Job instruction is a simple, four-step method of passing on the know-how to the learner.

Each member of the group is asked to prepare a job training demonstration involving an operation which can be presented and practiced within 15 to 20 minutes. Another member of the group is selected as a learner in the demonstration. The supervisor prepares for this demonstration by making a job breakdown sheet, which includes a listing of the important steps in the doing of the job and the key points which might make or break a job, injure the worker, etc.

Following the demonstration, the group is asked to discuss the effectiveness of the instruction job from the point of view of preparation, presentation, try-out (by the learner), and follow-up. This is done so that the men gain an understanding of the principles involved and their application.

Opinion Survey Held

At the final meeting of the total program, we conduct an opinion survey, in an effort to uncover improvements which we might make when the program is presented to the next group of new supervisors. We also have a little graduation ceremony, presenting each supervisor with a certificate signed by company officers.

What do the supervisors themselves say of this approach to basic supervision training? Here are a few comments collected at random over the company:

"In my duties as maintenance foreman I have found the following to have been most helpful: 1. job instruction training; 2. job relations training; 3. bargaining agreement; 4. human relations; 5. company organization and policy. In addition, I have enjoyed and profited by the informal sessions during recess and luncheons, in talking over some of the problems that daily confront us in generating stations."

"The entire program, in my opinion, has been very beneficial. Although I cannot relate any definite examples of when and where any part of the basic supervision program has been specifically used, I feel that the knowledge gained throughout the entire program has had a definite bearing on the execution of my daily supervisory duties, mainly because I am better informed and thus more capable of satisfactorily solving the numerous problems that arise."

"The association with other supervisors was very enjoyable and that acquaintanceship, while not a part of the formal program, has proved a valuable source of resolving mutual problems to the benefit of our company."

"The instruction in job relations and job instruction has proved most helpful to me." THE END

260-Ft Transmission Tower Gets Wind Load Test

FIRST full-scale transmission tower to be subjected to pressures equal to those of hurricane winds is a 260-ft structure designed and built by Alprodco, Inc. The slender tower was tested by forces equal to 85-mph winds, and was undamaged after the test, its minor deflections being well within the limits prescribed by microwave's "line-of-sight" operation.

New triangular design of the tower was developed by C. A. Mitchell, chief engineer for Alprodco. The tower is lighter in weight and reportedly lower in cost than conventional types, and is easily erected in 20-ft sections. The tower was built from structural tubing supplied by Armco Steel Corp.

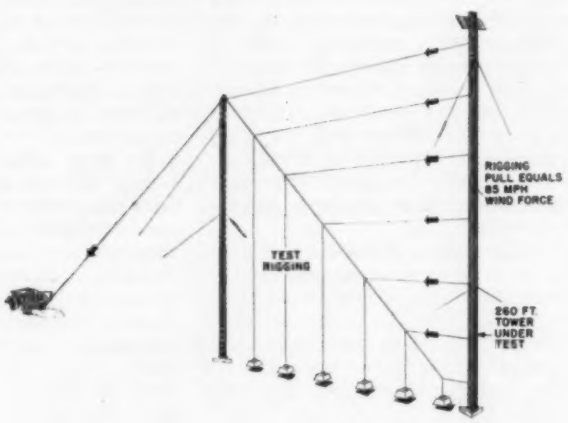
To test the structure (see sketch) a 240-ft auxiliary tower, supporting a complex system of weights and cables, was erected alongside. A winch applied even pull to the test tower from ground level to the peak. Stresses at essential points were calculated from strains measured with wire gages bonded on tower members and connected to instruments in a laboratory on the ground.

The tower's twist was measured by use of a surveyor's transit aimed at a mirror on the tower's top. Deflection was measured by another transit sighted on the tower from the side.

Under forces equal to 85-mph winds, the top of the tower deflected only six inches, and maximum twist was about one-half of one degree. Neither change exceeded the allowances permitted microwave towers — which beam their ultra-high frequency radio signals on a precise line from one tower to another.

Small tower sections have been tested to prove engineering formulas, but this full-size test is reported to be the first of its kind.

Growing by leaps and bounds, microwave communications systems are now being used by many industries to link plants and offices. Pipeline companies, for example, find microwave especially useful in monitoring pumping stations. Most network TV programs now follow microwave paths, replacing earlier use of coaxial cables.



When weights were lifted off ground by pull from heavily-loaded anchor truck, they produced horizontal pull (through the cables) on test tower at right. Enough weights were added to cause pull equal to force of 85-mph storm wind

High-Temperature Hot-Water System Succeeds at Erie Taconite

Now entering its third winter of operation, this type of heating plant, relatively new to the United States, is proving its value to its owners in northern Minnesota. Containing vast quantities of heat, its inherent stability is one of its most important assets

By E. G. HANSEN*

WHEN THE ERIE Mining Company carved its $300,000,000-plus taconite plant out of the rugged Mesabi range in northern Minnesota, a high-temperature hot-water central heating system was selected.

As the heating system begins its third winter of operation, its performance has more than justified the expectations from the high-temperature, high-pressure hot-water type of system. It is highly reliable, virtually maintenance-free, and extremely easy to operate.

Boiler plant consists of two controlled-circulation hot-water generators, having a design pressure of 350 psig, a working pressure of 275 psig, and a rating of 65,000,000 Btu per hr each, when heating 550,000 lb of water per hr to 414 F. Continuous overload capacity is 110 per cent, or 71,500,000 Btu per hr. Primary fuel is coal, with oil as a standby fuel.

Provisions have been made for the installation of a third boiler in the future, if needed.

These boilers discharge into a common drum 58 feet long and 10 feet in diameter, which holds 33,575 gallons when full. This drum is mounted above the boilers and serves as an accumulator and expansion tank. It is capable of absorbing a change of the specific volume of the water contained in the system of up to 17,000 gallons, corresponding to roughly half the cubic content of the tank. (The expansion of the working fluid between the filling temperature and the operating temperature is in the order of 14 per cent.)

Saturated steam fills the space above the water, and the correct pressure is maintained by keeping the temperature of the water entering the drum from the boilers constant at 414 F.

Three groups of pumps serve to circulate the water in three distinct but interconnected circuits. Three pumps, one a standby, constitute the boiler recirculation system. The main building-heating-system circulating system likewise has three pumps, and the process-heating system has two pumps, one of which is in continuous operation, the other an alternate.

The latter system, the process heating system, is a year-round operation, and is therefore separated from the building heating system as shown in Fig. 6. Purpose of this system is to heat the vast quantities of heavy oil used to heat the huge shaft furnaces which bake the high-grade iron ore pellets into the final form.

Ease of operation has been one of the features of the plant during its first two years. As shown in Fig. 6,

* Manager, Supertherm Department, J. O. Ross Engineering Division, Midland-Ross Corp

Fig. 1. Acres and acres—this vast complex depends on heating plant, shown under construction in exact center of this photograph, for all of its comfort and process heating. Operating experience has proved this system well-adapted to climate

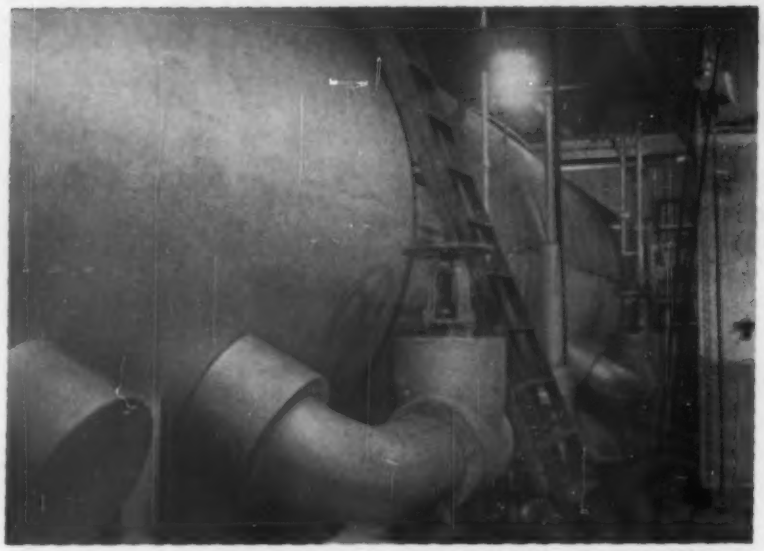


Fig. 2. This 58-ft expansion tank and accumulator helps cold-weather stability

automatic control valves are installed in mixing lines for the purpose of controlling the temperature of the water leaving the plant.

This is necessary to prevent flashing and water hammer in those buildings which are high enough above the heating plant that the difference in head would reduce pressure to below the saturation pressure for full boiler temperature. Operation of these valves has been without incident or complaint. The highest point, incidentally, is approximately 190 feet above the water level of the expansion tank.

Temperature of the water leaving the boilers is maintained constant by combustion control systems controlling the fuel-firing rate and combustion air supply. Low-flow and low-water-level cutouts stop the firing completely after a warning signal at an intermediate point.

Balance of flow between the boilers is maintained manually, but this has proved to require little adjustment once the flows have been balanced. Flow through the distribution system is virtually constant since the vast majority of Btu requirements are satisfied by water-to-air heating units, with the control on the air side. A few heat exchangers are controlled by automatic valves on the discharge-water side, but fluctuations in flow are slow and represent only a small percentage of the total load.

Since there are no automatic control valves controlling the flow to each user, proper balancing of the system is of utmost importance, and the pressure drop through every branch of every user was calculated, and valves and connections were sized to achieve a natural balance. When natural balance could not be achieved by sizing, throttling orifices were calculated and installed. The success was proved by the fact that the heating system was started up and has been operating satisfactorily without any balancing necessary in the field.

Flow in the process heating system is constant, and the leaving temperature is 400 F. This is possible since elevations are not as great as those in the district system.

Lack of operating difficulties is further made apparent by the fact that with only the help of an operating manual, written by the designers of the plant, the then J. O. Ross Engineering Corp, the system was filled and started, and operated ever since, by personnel not previously in any way familiar with a high-temperature hot-water plant!

Make-up Water

System's only water losses are supposed to occur through pump glands and valve packings, excluding piping leaks, which have to-date been virtually non-existent.

Makeup for the system runs to about 1400 gallons per day, which, for a steam plant of this size, would be inconceivably small. However, for a completely-closed, high-temperature hot-water system this figure is high. This is because the people in the plant have discovered that water, even at high pressures, does not explode when discharging into atmosphere, and that it can in fact be collected quite easily and harmlessly in a bucket and then come in handy for floor washing and other uses.

As a consequence, water is being surreptitiously withdrawn from the system through vent and drain connections by personnel out in the plant. The maintenance men now have a detective's job on their hands to find the culprits, and stop the malpractice. Water available needs little

Fig. 3. Through thousands of feet of tunnels such as these, hot water, 380 F, is distributed for heating and process

Fig. 4. Maintenance is held to a minimum in the high-temperature water system. There are no traps or condensate lines

treatment, only filtering and a small amount of sulfite.

Perhaps the only operating difficulty which has occurred has been the freezing of vent lines in certain cold areas. Original design brought these vent lines down to operating levels, so that no ladders were necessary — even though these lines are seldom used. During construction, however, certain parts of the building enclosures, such as pipe galleries, were omitted or left uninsulated in some places, and this caused the freezing of the stagnant water in the vent lines.

Effective remedy has been to cut the vent lines short and install the valves right next to the mains. In some cases the insulation next to the vent lines has been removed, but this has resulted in uneven heating. This difficulty is now being eliminated.

One of the greatest advantages of the plant for severe-winter operation is the large amount of heat content. Designers estimate that on a normal winter day the system would operate without fire in the boilers for three to four hours without noticeable temperature change in the heated areas. This heat storage, of course, also contributes to the stable operation of the system and the uniform operation of the boilers.

Ease of operation is reflected by the rather low personnel requirements. There are two operators per shift to run the boiler plant, including fuel and ash handling, and the air compressors for the processing plants, which are located in the heating plant, shown in Fig. 5.

Maintenance Procedure

Maintenance of the system has been, and apparently will remain, remarkably low. Complete absence of traps and condensate lines undoubtedly is a major contributing factor. The simplicity of a closed system is regarded favorably by all concerned, avoiding maintenance problems in such areas as that shown in Fig. 3.

The entire heating system of this tremendous plant, plus all dust control equipment, is handled by a crew of two mechanics, one fitter and one helper. Actually, dust control in a plant, which reduces some 7½ million tons of hard rock a year to face-powder fineness, is a job of major importance, and most of the time of the maintenance crew is spent changing viscous filters. In addition is the repairing of fire lines, the maintaining of heat exchangers and heaters, and the operating of a number of portable generators. The heating system takes very little of their time.

Pumps, air compressors, and other plant equipment are maintained on a regular schedule, with complete records kept of each overhaul.

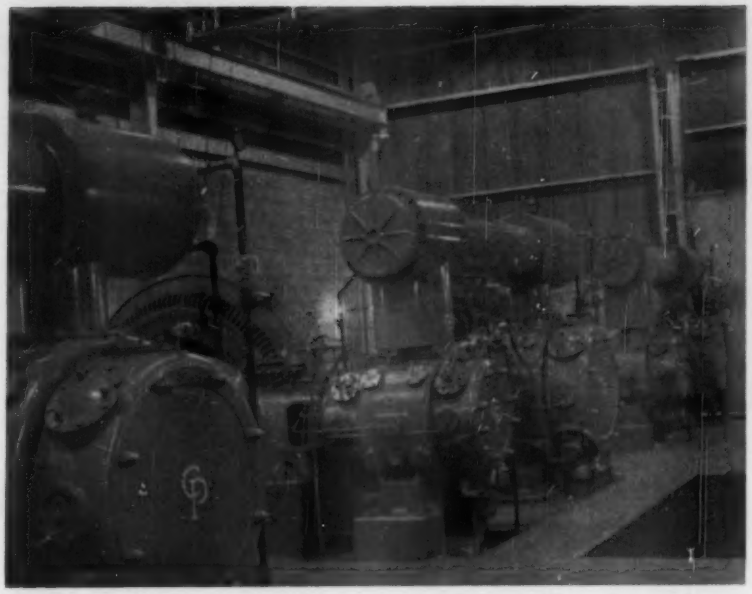


Fig. 5. Included in the power plant is this set of three large air compressors

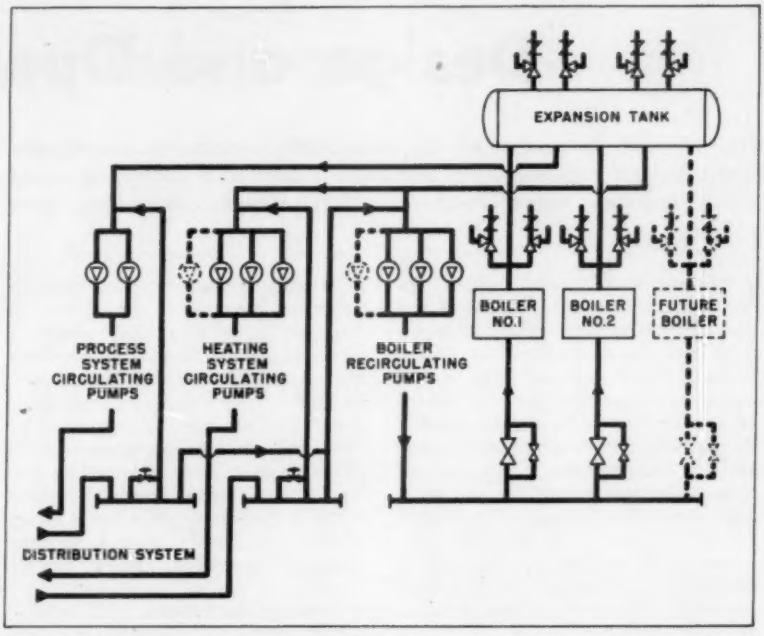
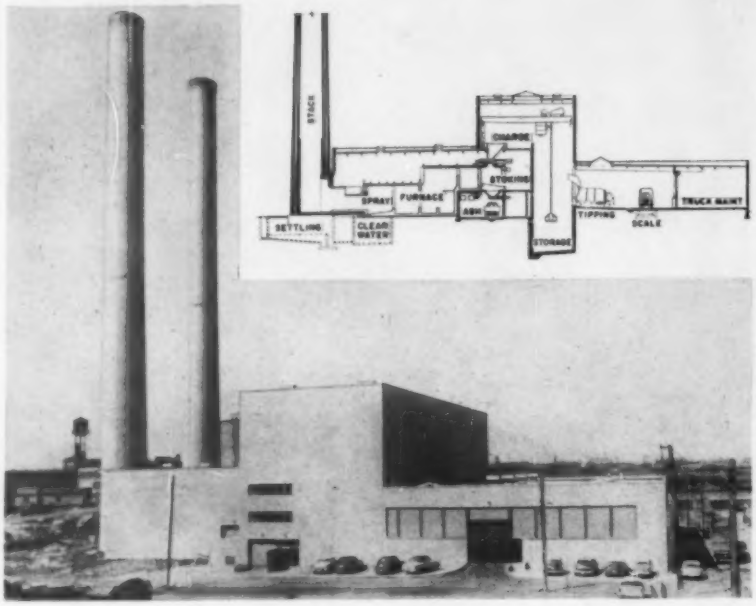


Fig. 6. Flow diagram for the system, including provisions for future additions

Electricity for the entire plant is furnished by Erie Mining's new power plant at Taconite Harbor, 74 miles away on Lake Superior. In the event of an outage, two 4160-v, 1250-kw diesel generators are available for essential services. While these do not start automatically, there is a detailed procedure for operators in event of such an emergency.

Taconite Harbor, incidentally, was built on the north shore of Lake Superior, especially for the purpose of shipping pellets to the steel mills. They are transported from the plant on a company-owned railroad built for the purpose. Facilities allow the unloading of 120 eighty-ton carloads in 20 minutes.

There are many additional features, including the raising by 30 ft of a lake supplying water through seven-mile-long lines. These will be described in future issues. THE END



Why This Article

Our rapidly expanding population and an increasing demand for better public sanitation have sharpened the problem of solid waste disposal, both for industry and municipalities. Converting such waste to a decontaminated inert residue of 5 to 10 per cent of its original volume is fast becoming standard practice for American cities. Use of the heat generated is an important aspect

Fig. 1. Exterior and sectional elevation of the new 720-ton capacity Medill incinerator in Chicago. Waste is dumped in storage pit, then transferred by traveling crane to four 180-ton furnaces and burned on mechanically-operated rocking grate stokers

Design and Operation of the

The ultimate in design of an incinerator furnace is a complete water-cooled enclosure. This discussion is part of a continuing series which includes waste heat utilization, stokers, stack problems

By JOHN H. D. BLANKE *

COMMUNITY solid waste incinerators are subjected to severe operating practice. Charged waste may range from rather low to extremely high combustibility in the course of a day. Operation may be intermittent for 8 or 16 hours instead of 24. As a result there are extreme variations in temperature, which demand close attention to suitable design of refractory. Heat shock and spalling of brickwork occur in furnaces subjected to the temperature changes of intermittent firing of refuse, admittance of too much excess air, and periodic shutdown.

A superior type of wall and roof construction is recommended for incinerator furnaces. A check on 25 large municipal incinerators showed seven installations using suspended wall construction in the furnace, and most of the seven installations used similar design in the cooler parts of the plant, including the dust-settling chambers and flues.

For example, a New Orleans incinerator has walls of castable refractory, insulated from the steel casing. Most of the walls of the flues and combustion chamber are sectionally constructed. Roof construction is of suspended refractory tile. An incinerator furnace in St. Louis is designed with air-cooled walls of sectional construction. The fire brick wall is separated from the exterior furnace wall by about six inches of air space. The fire brick is supported by horizontal steel beams spaced about 36 inches apart and supported by vertical steel columns. Specially formed firebrick stops over the interior flange of the horizontal beams prevent direct exposure of the steel to furnace heat.

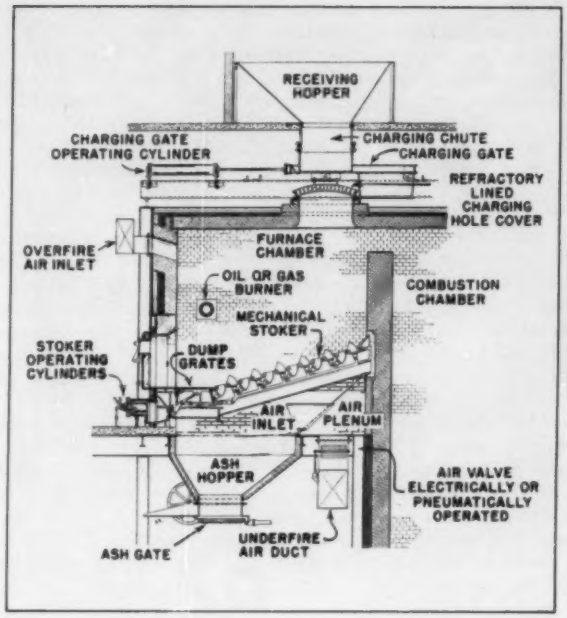
Damage to furnace brickwork is minimized by maintaining a constant or regulated temperature. An inrush of cold air into the furnace can be avoided by using sealed refuse charging gates, sealed ash discharge gates, also by continuous and regulated feeding of refuse and discharge of incombustibles. An additional caution is the preheating of air in furnace wall spaces, using air from the plant interior and preferably from the refuse storage pit.

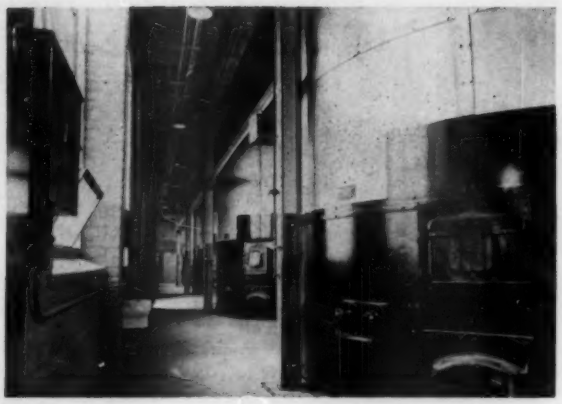
The ultimate in design of an incinerator furnace is a complete water-cooled enclosure. Such design would also require less overfire or excess air to cool gases of combustion and demand relatively smaller dust settling or precipitating facilities, besides resulting in cleaner stack discharges.

An ideal situation for maximum protection of furnace walls arises in the incinerator plant equipped with auxiliary or stand-by gas or oil burners which, thermostatically controlled, keep the brickwork from excessive chilling during shutdown or during intermittent refuse firing. The auxiliary burners can be used to support combustion of refuse low in heat value, and to generate heat and power for plant uses and other applications, which is a desirable scheme for the maximum possible conservation and utilization of available heat resources.

In some installations the incinerator furnace is protected against overheating by indicating and recording pyrometers which automatically control the supply of overfire air; the fans start when the furnace temperature reaches 1800 F, and continue air delivery until the preset temperature is regained. Other incinerator fur-

* Technical writer. Member of Western Society of Engineers

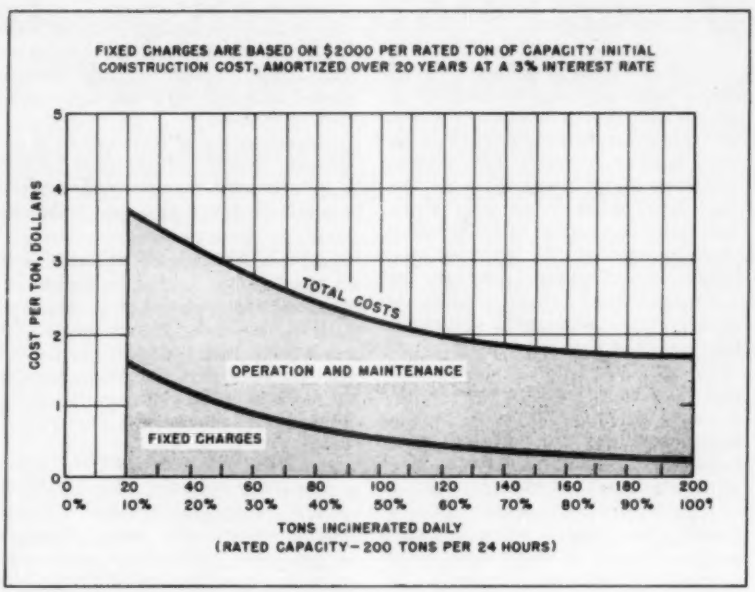




Figs. 2 and 3. Elevation of intermittently charged incinerator furnace fitted with mechanical stoker and using oil or gas for auxiliary firing. Combustion chamber adjoins at right. (Above) Interior of 700-ton community waste incinerator in Hempstead, N. Y. Combustion chambers deliver the hot gases to two waste heat boilers rated to produce 120,000 lb of steam in 24 hr. Part of it is delivered to 1000-kw turbine generators that supply electricity throughout the plant

Big Incinerator Furnaces

Fig. 4. Estimated cost curves at various percentages of plant utilization per 24 hours. Based on U. of California study


FIXED CHARGES ARE BASED ON $2000 PER RATED TON OF CAPACITY INITIAL CONSTRUCTION COST, AMORTIZED OVER 20 YEARS AT A 3% INTEREST RATE
COST PER TON, DOLLARS
0
1
2
3
4
5
TOTAL COSTS
OPERATION AND MAINTENANCE
FIXED CHARGES
0 20 40 60 80 100 120 140 160 180 200
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
TONS INCINERATED DAILY
(RATED CAPACITY – 200 TONS PER 24 HOURS)

naces are equipped with an automatic alarm that sounds when the temperature in the combustion chamber exceeds a preset upper limit and continues sounding until normal operation is restored.

In the 900-ton incinerator in Miami the temperature of the gases in the six furnaces is controlled by overfire draft adjustment. Thermocouples located in the combustion chamber open air-entrance louvres whenever the gas temperature in the furnace rises above the predetermined upper limit of about 1800 F. Cool air then enters the incinerator over the fire and evens out the flashes of high temperature that are produced by rapidly burning charged refuse. Dampers permit delivery of the hot furnace gases either to the waste heat boiler or directly to the stack.

If too much overfire air is delivered to the incinerator furnace, the gas velocity to the stack may increase abnormally, thus reducing residence time of combustibles in the furnace and resulting in excessive discharge of dust and other air pollutants, besides unduly chilling the refractory linings.

It seems therefore desirable to maintain proper furnace temperature by dissipating heat of combustion to water-cooled walls or preferably by controlling the burning rate of the charged refuse. Constant or regular feeding of blended waste from the storage pit aids in maintaining a proper fuel-air ratio and in promoting complete combustion. Flash-burning of highly combustible rubbish should be avoided by proper blending of waste before charging to the furnace.

Almost without exception, the waste delivered by collector trucks to engineered incinerators is weighed on recording 20- to 30-ton scales. Trucks dump generally into a refuse storage pit designed to hold one and a half

Figures courtesy of: Chicago Bureau of Sanitation, 1; sectional drawing, Fig. 1, *The American City;* Pittsburgh-Des Moines Steel Co, 2; Morse Boulger Destructor Co, 3; *Engineering News-Record,* 4

to two and a half times the per-day capacity of the incinerator. Most pits are about 24 feet wide, about the same measure in depth, and extend the full length of the furnace charging floor, which may be up to 200 feet, or more. It is of course desirable to operate collector vehicles five days per week, the incinerator six days, the seventh for plant cleanup.

Refuse pit capacity may range from 4 to 8 cu yd per ton of incinerator capacity per day. In 16 recently checked incinerators, the pit capacity ranged from 2.7 to 10 cu yd per ton incinerator capacity per day, with an average of 4.7 cu yd.

Use of a storage pit affords the necessary opportunity to mix and blend the incoming loads of refuse so that a more uniform fuel can be delivered to the furnace, which in turn results in better combustion and more complete incineration.

Handling the Waste

Refuse dumped into the storage pit is retrieved and charged to the incinerator furnace by means of a clamshell bucket or grapple suspended from an overhead traveling crane. Sometimes the grapples are fitted with long tines which aid the operator in mixing the dumped refuse before charging the furnace. Generally the buckets are of 1½ to 2½ cu yd capacity, but may be 5-yarders.

Wall along the discharge side of the storage pit is often sloped. It affords the crane operator a better view when the discharge gate of the truck is down. Damage to the pit wall is prevented by facing the wall with steel liner plates. Floor area where the crane bucket is idled is sometimes protected with armored steel facing. To protect crane operator and equipment from possible fires in the refuse pit, an overhead or side sprinkler system is recommended.

Proper control of dust, gases, odors and insects in and about refuse storage pits and on furnace charging floors is important. Water spray nozzles spaced along the upper edge of the pit and operated continually at regulated rate will precipitate dust arising from handled refuse. Possible accumulations of dangerous gases originating from stored refuse at the bottom of the pit can be withdrawn by continuously turning fans through orifices in the wall and discharged to outdoors or furnace. Nuisances of odors and flying insects may be abated by means of chemical spray nozzles spaced along the pit. Drain at the pit floor will serve to discharge liquids from waste and washdown.

Air withdrawn near the pit floor for safety reasons and at the pit opening for removal of rising dusts may be delivered to the furnace for combustion and simultaneous disposal of the dust and gas, or it may be discharged to the outdoors by way of suitable filters. Before entering the incinerator furnaces, the air may be preheated in furnace wall spaces.

Capacity of Grates

Hand-stoking of refuse on stationary or movable grates has been customary. However, the modern community incinerator is equipped almost without exception with hydraulically-, mechanically- or electrically-driven stoker grates. Incinerators of vertical cylindrical design are fitted with rotating arm stokers available in several designs. The rectangularly-shaped incinerator is customarily fitted with a horizontal or inclined rocking grate stoker. Use of controls permits almost automatic operation of the incinerator from refuse charging chute to the ash dump.

Average weight of refuse ranges from 300 to 350 lb per cu yd. Great variance in grate loading exists in engineered incinerators, as to design. In 92 municipal installations made during 1949 to 1956, the designed loading ranged from 15 to 150 lb of refuse per sq ft per hour. Specifically, the indicated loading ranges were 15 to 111 lb for hand-stoked grates, 25 to 150 lb for rotating circular grates, and 44 to 83 lb for rectangular rocking grates.

Grate loading of 60 lb per sq ft per hour is generally considered acceptable, although conventional practice considers a 55–98 lb range. To cite an example, the incinerator in Huntington, N. Y., is designed to burn 56 lb of refuse per sq ft of grate surface per hour. Grate area of an incinerator may, however, be determined on the basis of a heat release of 300,000 Btu per sq ft per hour, equivalent to 30 to 35 lb of *dry* refuse per sq ft per hour, free of inert solids.

Combustion Chamber

Generally speaking, the combined volume of the furnace and combustion chambers has been placed at 25 cu ft per ton of rated incinerator capacity. However, basic design data derived early in 1957 from a dozen incinerators shows an average combined volume of furnace and combustion chamber of 29.5 cu ft per ton of rated capacity. Furnace volume alone has been an average of 12 cu ft per ton, with a range of 9 to 16 cu ft in 11 plants.

Combustion chamber volume has averaged 17.5 cu ft, with a range of 10 to 27 cu ft per ton in 12 incinerators. Of interest is the fact that among nearly 100 municipal incinerators built during 1949 to 1956, the median plant had a furnace volume of 9.6 cu ft per ton of rated capacity for garbage and combustible rubbish, 10.0 for refuse, and 11.6 for combustible rubbish alone.

The combustion chamber may serve one or two incinerator furnaces, depending on desired plant layout. In rotating stoker installations, the chamber is connected to the circular furnace by a transition box. In rocking grate installations, the chamber adjoins the rectangular furnace. When traveling grate stokers are used, the combustion chamber is integral with the furnace.

Temperature of combustion must be maintained within specified limits to protect the incinerator furnace, to destroy odors of refuse and to minimize pollution by stack discharges. A temperature of 1500 to 1600 F burns or destroys the gaseous pollutants, reducing them to sulfur dioxide, carbon dioxide and water. Recommended temperature range is 1500 to 1800 F.

Putting Waste Btu to Work

In order to protect brickwork and linings against damage by heat, it is desirable to cool the flue gases generated by incinerating waste before they pass up the stack. Although protection can be given by directing excess air over the fire, with concurrent higher emission of fly ash from the stack, it is more desirable to pass the incinerator furnace gases through a waste heat boiler or other heat exchanger that not only cools the gases but captures heat units for making hot water or steam. The heat value in refuse is of course utilized to better economic advantage if the incinerator can be operated continuously throughout the week. Such operation would assure longer plant life, less damage to refractory due to maintaining a more constant furnace temperature, and other advantages of continuous operation.

Unfortunately, most incinerators are operated by necessity at the most six days a week. In order to maintain reasonable temperature in the incinerator during shutdown periods, a stand-by heating plant appears desirable. Such a stand-by plant, if not fired directly by oil or gas fuel, could well be a hot water or steam storage tank which would be charged with Btu extracted from waste heat produced during incineration operation. Heat accumulating in furnace wall spaces may be utilized in preheating air for refuse drying, ignition and combustion, thereby assisting in effecting better and more uniform burning of waste. THE END

Fig. 1. Efficient heat-absorbing platens added to existing unit are shown. Third one, near camera, is not visible here

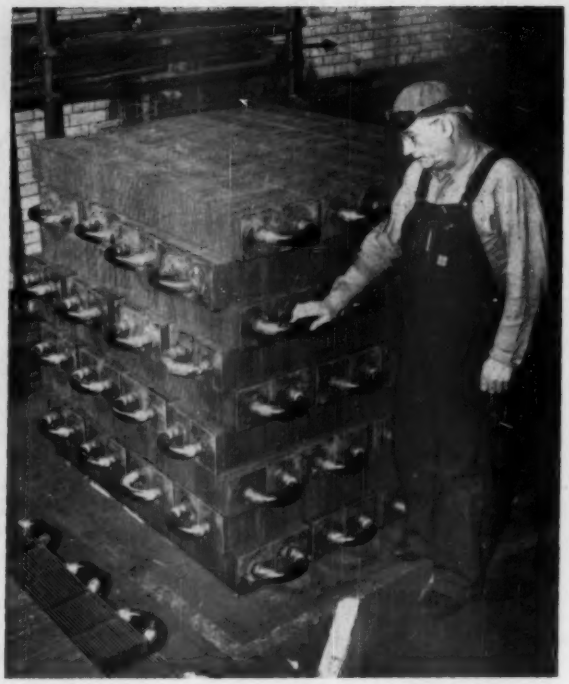


Fig. 2. Fin-tube elements that were added to economizer. Rectangular ⅛-in. aluminum fins increased surface 40 times

Remodeling Boiler Adds Capacity To Twenty-Year-Old Unit

Addition of more boiler tube and economizer surface enabled Wisconsin Electric Power Co to upgrade old 80-mw unit by 10 mw of added power at an over-all cost of $35 per incremental kilowatt

By M. K. DREWRY*

MODIFICATION of a twenty-year-old generating unit recently permitted Wisconsin Electric Power Co to add 10,000 kw of added capacity at an incremental cost of $35 per kw. Opportunity was taken of a four-month scheduled maintenance outage of an 80,000-kw unit to increase its capacity to 90,000 kw and to improve boiler efficiency of the unit.

Improved generator windings permitted the higher output. The turbine had adequate capability, and the boiler was boosted to the greater output by adding more furnace cooling surface and by installing an economizer before the air heater. Addition of furnace water tubes to avoid slagging at the higher load required more surface for the convection superheater and the radiant reheater to maintain normal steam temperature.

Added capacity of 10,000 kw was obtained for a total expenditure of $350,000, or $35 per incremental kw. Capitalized coal savings due to the resulting 100 F decrease in final flue gas temperature, at the steadily decreasing output of this 20-year-old unit, equal $11 per kw, thus affording this additional capacity at a net cost of $24 per kw. Twenty per cent average load factor is estimated for the next 20 years, based on experience.

More Power With Same Labor

No added labor costs will apply to the incremental capacity, and total maintenance is expected to be no more than before the modification. No credit for these, nor for better use of transmission lines, is assumed in the above calculation, however. Estimated minimum value of this capacity, added at mid-life of the unit, is $73 per kw. This 10,000 kw was thus obtained at one-third its minimum value.

Experience attained by modification of 300-psi boilers at our Lakeside plant in 1941, from which we gained 35,000 kw at a unit cost of $4, pointed the way toward this improvement at our Port Washington station. Use of under-arch platens in Lakeside's first 1300-psi boiler, installed after the unit was 24 years old in 1950 and which also achieved important capacity and efficiency gains, was a further precedent for this Port Washington improvement.

Incidentally, our Oak Creek plant also uses the same type of under-arch platens as we first employed in the Lakeside boiler, which was the second 1300-psi boiler to be installed in the U. S. These arches, being in the region of highest furnace heat transfer, limit furnace temperatures and ash troubles importantly. Their recent application at Port Washington is shown in Fig. 1.

Experience gained in the building of eight extended-surface economizers at Lakeside in 1941 to fit into very limited space encouraged the use of somewhat similar design at Port

*Chief of Power Plants, Wisconsin Electric Power Co

Washington. Here, the space available between boiler and air heater was extremely limited. Use of rectangular aluminum fins, closely spaced in all three dimensions, permitted 100 F reduction of the air heater gas outlet temperature. Some of the finned tubes, ready for installation, are shown in Fig. 2.

Heat transfer ratio, or the economizer tube surface multiplied by the number of fins, is increased forty times. Urged by the rigorous space limitations, this is perhaps the highest heating surface ratio used commercially. High thermal conductivity of aluminum and the use of adequately thick fins facilitated this high ratio without much sacrifice in heat transfer performance.

Higher coefficient of thermal expansion of the aluminum fins than of the steel tubes posed a problem of maintaining tightness of contact at operating temperatures. Extensive study proved that the use of steel spacer rings between the fins, causing axial contacts, would result in gaining increased pressure rather than decreased contact when the assembly was hot.

Initial tightening was accomplished by expanding the tubes and rings hydraulically with 20,000-psi water pressure. A cylinder-piston arrangement simultaneously used this high fluid pressure to furnish gasket "squeeze" at the tube ends, with the desirable result that the expanding operation required but a couple of minutes per tube.

Furnace temperatures are substantially less at 90,000 kw than was previously the case at 80,000 kw. The additional superheater tubes and reheater tubes reduce pressure drop, and thus heat rate, for which credit was not taken in the cost-per-kw calculations. Superheater and reheater metal temperatures are lower because of substantially lower heat transfer rates despite the higher load.

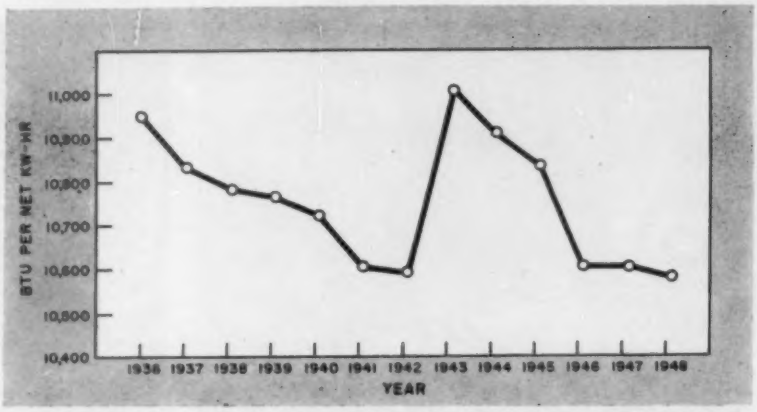


Fig. 3. For thirteen years Port Washington enjoyed lowest steam plant heat rate in U. S. Recent modification improved the first unit's heat rate by 2½ per cent

Ash trouble margins, desirable for burning the low ash-fusion temperature coals of southern Illinois and western Kentucky, were enhanced. Three years of favorable experience, established since the modifications were made, proves them reliable and efficient.

This particular single-boiler, single-turbine installation, conceived in 1929, set the pattern for four successive units and afforded the Port Washington station the unusual distinction of averaging the lowest annual heat rate for thirteen successive years. These lowest steam station heat rates, as confirmed by Federal Power Commission reports, are plotted in Fig. 3. The current improvement suggests that always is there "room for improvement". That improvement of highly efficient 20-year-old equipment can prove economic seems significant.

Low load-factor apparatus will always be required unless established annual system load factors of 50 to 60 per cent can be greatly increased. This hardly seems likely in the foreseeable future. With diminishing heat rate differences of recent plants, as contrasted to very large differences with many old plants, capacity gains through modification of middle-aged plants are sometimes warranted.

Equipment reliability throughout Port Washington's history has been unusually high. Recent modifications of Unit 1 are further improving its record in this vital aspect of dependability. THE END

Design Industrial Power Plants for Flexibility

POWER ENGINEERS, faced with pressures from management for continuous production due to costs and intangibles such as acute market problems, find their attitudes molded to give major emphasis to dependability in the selection of power equipment, according to H. R. Emery, Staff Power Engineer of St. Regis Paper Co, before the American Power Conference recently.

In order of their importance: dependability, initial cost, serviceability, and efficiency are the factors that govern selection of industrial power equipment. Any of these factors, being outstanding, will undoubtedly cause those interested to investigate the other three.

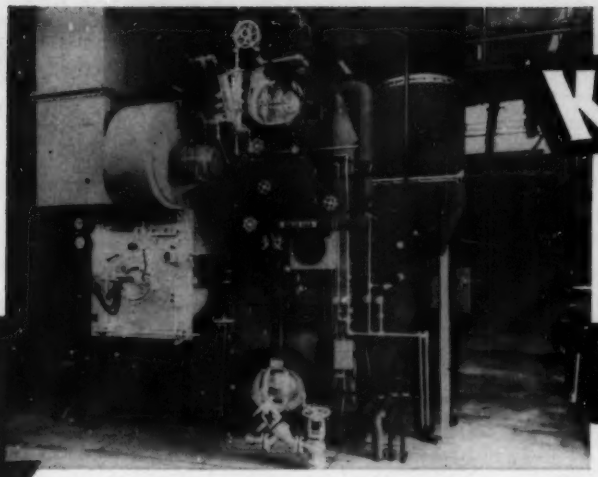
Influence of this type of design has already made itself left in the field of power plant auxiliaries, where it has been demonstrated that cost of a next-size-larger unit is less than that of one specially engineered for the job.

Use of multiple fuel for steam generation in a single unit has been well-explored by many of the boiler companies, and industry will continue to ask that these units be made available, dependable, competitively priced, and reasonably efficient.

Multiple extraction condensing and non-condensing turbines will always be in demand. No one manufacturer has entirely solved the problems involved in governing two or more steam pressures, maintaining load, and holding frequency with these units, according to Emery.

While efficiency, assuming reasonable ranges, is ranked fourth in order of importance in considering new power plant equipment for industry, deviation from this ranking may well be brought about by ever-increasing fuel costs. These increases will change this order of importance first in plants where steam is generated 100 per cent on purchased fuel, and progress later to plants with by-product fuel; such is the case with pulp and paper mills.

In designing for the future, power engineers should attempt to minimize the adverse effects of anticipated trends. Designing for multiple fuels is common. To reduce Btu losses as the trend to more kwh required for the same amount of steam continues, some engineers deliberately set initial steam pressures higher than required and operate on a by-pass around extraction turbines, thus keeping condenser loads at a minimum now and in the future. Units are sized and grouped to minimize the number of operators required.



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(*Indicates more than one unit)

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Power Engineering handbook

Corrosion by CO_2 in Steam Condensate Lines

This discussion, and one which will follow it, originated in a paper presented at the Chemical Engineering Section of the VII Latin-American Congress of Chemistry held at Mexico City in the spring of 1959

By RAMON M. GUZMAN *

IS YOUR BOILER A CO_2 GENERATOR? It probably is, if the correct feedwater treatment is not being provided. All natural waters contain dissolved gases, or chemical constituents which, upon breaking down, generate and liberate corrosive gases. The dissolved gases that may occur in water supplies are carbon dioxide, oxygen, nitrogen, hydrogen sulfide, methane and ammonia. Among these, dissolved oxygen and carbon dioxide are the major offenders and their action can be the cause of the need of expensive repairs and replacement of condensate lines.

In view of the simple methods for removal of dissolved oxygen, this paper is mainly confined to the rate of corrosion by carbon dioxide in the return lines. The outlines herein related will be confined to its generation, corrosive properties, mathematical relations and preventive measures that may be incorporated in the feedwater treatment, or steam system. This paper was developed for the most part from experience with boilers working at pressures below 300 psi at Naval shore installations.

* Special Assistant for Sanitary Engineering, Area Public Works Office, Caribbean, U. S. Navy, San Juan, P. R., PO Box 47, Rio Pedras

Dissolved oxygen reacts with iron and water to form ferric hydroxide according to the following reactions:

$$4\ Fe + 3\ O_2 = 4\ Fe(OH)_3 \quad (1)$$

$$2\ Fe(OH)_3 = Fe_2O_3 + 3\ H_2O \quad (2)$$

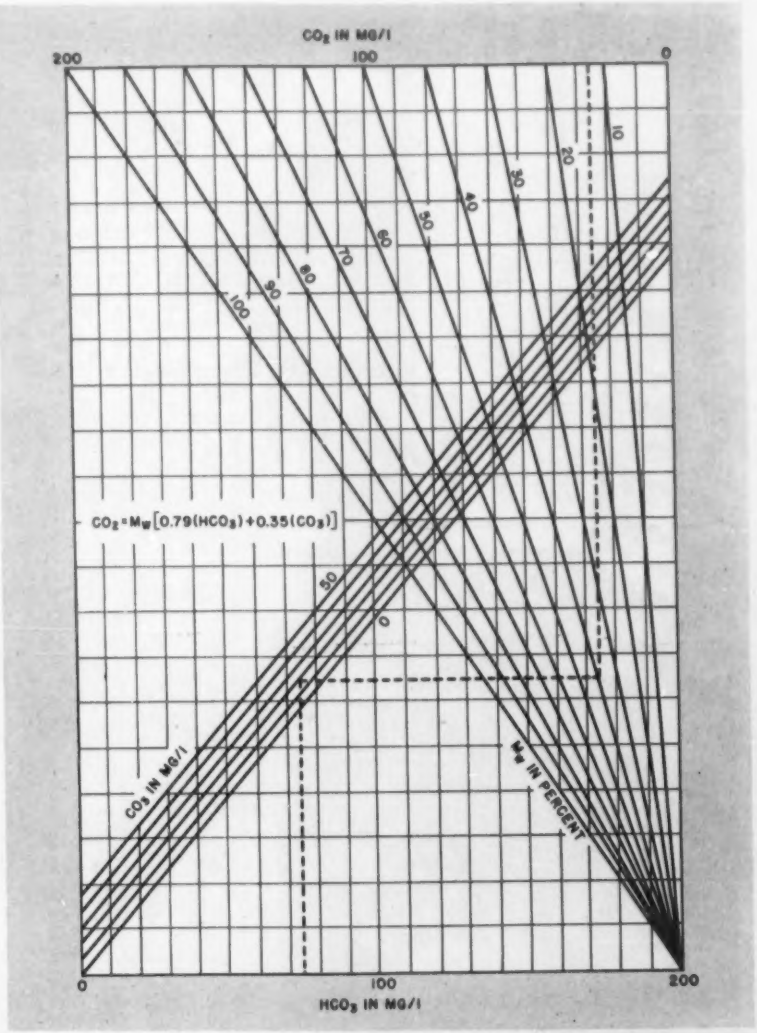
Removal of dissolved oxygen from the feedwater can be accomplished by relatively simple methods, i.e., heating the water in an open or deaerating heater, or by means of oxygen scavengers such as sodium sulfite and hydrazine. The addition of chemicals for removal of dissolved oxygen is desirable even when deaerators are used, because traces of dissolved oxygen will remain in the feedwater. Dissolved oxygen attack in the return lines is characterized by the formation of tubercles, under each of which is a pit and the presence of iron oxide.

Carbon Dioxide

Solubility of carbon dioxide in water at 32 F and atmospheric pressure is 1690 ml per liter. As the temperature increases, the volume of dissolved CO_2 diminishes; at the boiling point its solubility is zero.

Corrosion by CO_2 carryover is characterized by the formation of grooves and thinning of the metal pipe walls, particularly near the threads. This type of corrosion does not produce pits or deposits, such as caused by dissolved oxygen. Corrosion by CO_2 evolved with the steam presents a more difficult problem than that of dissolved oxygen, since

fold along this line—outside edges toward you



Relation between alkalinity, make-up water and CO_2 in steam. Example: Given HCO_3 75 mg/1, CO_3 20 mg/1, M_w: 40 per cent—find CO_2 to be generated in the steam. Find 75 on the HCO_3 scale and proceed vertically until the CO_3 20 line is encountered. Then proceed horizontally to the 40 per cent M_w line, then again vertically to the CO_2 scale and read result. This chart was developed from text equation (A)

cut along this line

TURBO-COMPRESSORS AND BLOWERS

2500 cfm and up

By Eugen P. Eicher, M.E., Brown Boveri Corp.

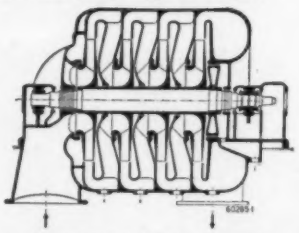
BROWN BOVERI

Brown Boveri offers complete compressor sets including compressor, choice of drives and all auxiliary equipment. Brown Boveri manufactures all the components, assembles and tests the complete sets in their own workshops and assumes full responsibility for the complete unit.

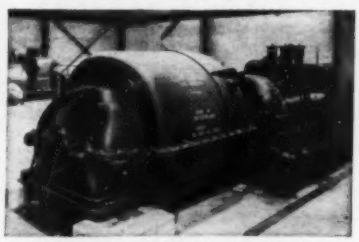
Compressors include a full range of centrifugal and axial types. Drives include steam turbines, gas turbines, expander turbines and electric motors. (Where hot waste gases are available, for example, a combination of motor-generator and exhaust-gas expander turbine drives has reduced power costs 60 to 70%.) Auxiliary equipment includes gear sets, pressure and volume regulators, air and gas coolers and complete electrical control systems.

Brown Boveri compressor sets are used by many leading U. S. companies and are backed by engineering skill, product reliability, and complete U. S. service staff and facilities.

2500 to 175,000 cfm at up to 60 psi* Uncooled centrifugal blowers



Four-stage centrifugal compressor.



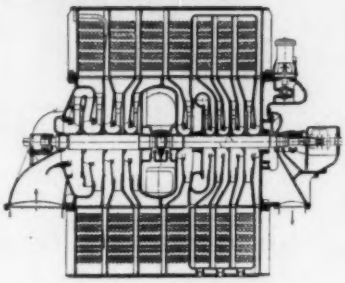
One of two 40,000 cfm centrifugal blowers with steam turbine drive in a copper conversion plant, Arizona.

First developed by Brown Boveri. Advantages over reciprocating compressors in the above ranges: lower cost, higher efficiency, less maintenance, less floor space and *clean, oil-free air.*

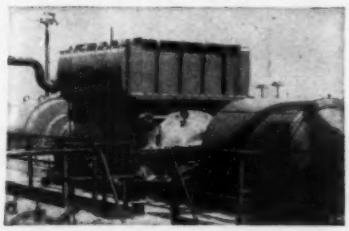
Standard designs are for air or non-poisonous, non-corrosive and non-explosive gases. Stainless steel impellers, shafts, etc. are available for corrosive gases. High-pressure casings and oil type sealing glands are available for higher pressures.

Applications: Blast furnaces, converters, coke ovens, gas distribution, process air and gases, air separation plants, sewage aeration, tunnel ventilation.

5000 to 80,000 cfm at 60 to 120 psi* Internally-cooled "Isotherm" centrifugal compressors



Nine-stage "Isotherm" compressor with anti-surge power-recovery turbine.



"Isotherm" compressor driven by a synchronous motor (left) and a waste-gas recovery turbine (right) at a California chemical plant.

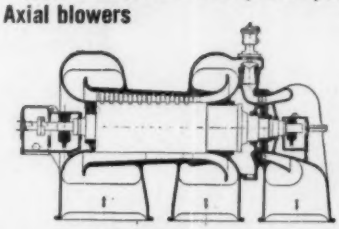
Highest inherent efficiency. Ten basic models with 6 to 9 stages per casing. Impeller diameters from approx. 1 ft. to 4 ft. The larger models include a built-in power-recovery turbine to allow running at loads below the surge limit.

Stainless steel impellers, shafts, etc. are available. For discharge pressures higher than 120 psi, "Isotherm" compressors are followed by an uncooled centrifugal compressor or other booster.

Drives: Four-pole synchronous motors are generally preferred for 1500 hp and larger units, other type motors for smaller sizes. Speed-increasing gears are used with all motor drives. Variable-speed steam or gas turbines are direct coupled.

The reliability of "Isotherm" compressors is proved by hundreds of installations in mines, shipyards, chemical process plants, air liquefying plants, aerodynamics laboratories.

10,000 to 500,000 cfm at up to 80 psi* Axial blowers



Ten-stage axial compressor with anti-surge power recovery turbine.

Axial blower, steam turbine drive, supplying 70,000 cfm of air for a blast furnace.

Substantially more efficient than centrifugal units for large air volumes where adequate pressure can be delivered with a single unit and without cooling. The higher efficiency allows smaller and better drives and lower cost. A power-recovery turbine may be built in to permit operation at volumes below the surge limit.

Drives. Steam turbines allow simple, automatic control through Brown Boveri pressure-oil governors with pressure or volume regulator. Brown Boveri gas turbines and electric motor drives of all types are also available.

Applications: Gas turbines, wind tunnels and chemical plants. In Europe, Brown Boveri axial compressors driven by gas turbines are widely used for blast furnace air with substantial power savings.

**Capacities for single machines. Higher discharge pressures can be obtained by combining various types of equipment in series.*

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its control is somewhat complex.

CO_2 in the steam has its origin from the carbonate and bicarbonate ions present in the feeder. The thermal decomposition of these ions occurs according to the following reactions:

$2HCO_3^- + \text{Heat} = CO_3^= + H_2O + CO_2$ (3)

$CO_3^= + H_2O + \text{Heat} = CO_2 + 2OH^-$ (4)

Reaction (3) is complete, but only 80 per cent of reaction (4) takes place in the thermal decomposition [1]. For every milligram per liter (mg/l) of bicarbonate alkalinity expressed as $CaCO_3$, 0.44 mg/l of CO_2 will be produced according to reaction (3), while reaction (4) will contribute with an additional 0.352 mg/l. Thus a total of 0.792 mg/l of CO_2 will be produced for every mg/l of bicarbonate alkalinity in the feedwater, plus 0.352 mg/l for each mg/l of carbonate alkalinity, if present.

CO_2 will combine with the condensate in the return lines to produce corrosive carbonic acid, as follows:

$$CO_2 + H_2O = H_2CO_3 \qquad (5)$$

Rate of this reaction depends on the amount of gas dissolved, which in turn is dependent on the partial pressure of the CO_2 in the return line [2]. As the source of the CO_2 is the boiler feedwater, the amount of make-up will directly affect the rate of CO_2 generation and consequently the rate of corrosion of the return lines.

Mathematical Relations

From reactions (3), (4) and (5) and the above data, it appears that the relation between the carbonate and bicarbonate ions, CO_2 and make-up water is as follows:

$$CO_2 = M_w[0.79\ (HCO_3^-) + 0.35\ (CO_3^=)] \qquad (A)$$

where

- HCO_3^- = bicarbonate alkalinity as $CaCO_3$ in mg/l
- $CO_3^=$ = carbonate alkalinity as $CaCO_3$ in mg/l
- M_w = percent make-up water as to feedwater, expressed as a decimal
- CO_2 = carbon dioxide generated in mg/l

Carbonate alkalinity is not very common in natural waters, although it is usually present in lime or lime-soda softened waters, and waters with pH higher than 8.3. Thus, for waters with pH equal or less than 8.3, equation (A) becomes

$$CO_2 = M_w\ (0.79)\ (HCO_3^-) \qquad (B)$$

Department of the Navy criteria call for a CO_2 in the steam not greater than 10 mg/l[3]. Although corrosion can exist even at this low level, the rate of corrosion is believed to be small for most of the boilers in use at Naval shore activities. Using a CO_2 concentration of 10 mg/l as an acceptable yardstick, the corrosion problems in the return lines can be predicted to a satisfactory degree for practical purposes.

The chart shown here was developed from equation (A), provides an easy way to estimate the CO_2 that will be generated in the boiler. For waters with pH equal to or less than 8.3, the zero line for CO_2 can be used as a pivot line to determine the CO_2 from the make-up water and bicarbonate alkalinity.

Rough approximation of the CO_2 that will be generated may be obtained by titrating a sample of the make-up water with standard hydrochloric acid to the methyl orange end-point and determining the bicarbonate alkalinity as mg/l of $CaCO_3$, since as a general rule, the amount of carbonate alkalinity in the water is low. In this case, equation (B) should be used for the estimates.

Volume of make-up water can be determined by adequate meters with the percentage of make-up to feedwater being calculated, or by chemical tests by determination of chlorides in the make-up and feedwater [4]. The test for chloride-ion, which may be determined by the Mohr method [5], requires only a simple titration and may be performed by non-technical personnel once the standard silver nitrate solution is prepared.

Corrosion Testers

There are various methods to determine quantitatively the corrosion that occurs in the return lines [6]. These are based on the use of special metals or alloys that permit the observation of typical corrosion patterns. Three of the methods used by the U. S. Navy for this purpose are the ring tester method, the NDHA coil method [7] and the Plate method. Any of these methods give reliable results when properly conducted

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fold along this line—outside edges toward you

Acknowledgements

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How We Simplified Control of Demand For Inside Temperature Changes

By R. A. CALDER *

OUR PLANT has a double row of offices, 240 feet long. One side has individual hot water room units, while the other side has hot air ducts from a central unit having hot water coils.

Hot water for all comes from a convertor with electronic motorized valve located on steam supply to the convertor.

This motorized valve coördinates signals from immersion discharge thermostat and an insertion thermostat for outdoor temperature.

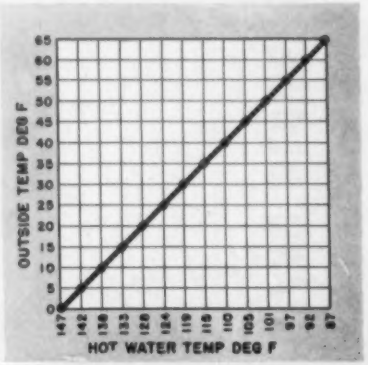
Function of outdoor thermostat is to raise control point of discharge thermostat from around 80 to 140 F as outdoor temperature drops from 65 F to zero. A control point adjusting dial raises control point of discharge thermostat as desired.

To prevent the adjusting dial from being turned too far and too often on demands for cooler or warmer temperatures from various offices, we kept a daily log for one winter.

When temperatures at ten different places in the offices were satisfactory and recorded on the log, we also recorded the time, outdoor temperature, position of adjuster dial and temperature of water in the circulating pump.

It was found that water temperature starting from 87 F up as outdoor temperature went from 65 F down, was satisfactory.

The panel was marked, opposite which the central point on the adjuster was placed to get this condition. A chart was made and hung on the wall over the pump, showing what the water temperature in the pump should be for any outside temperature ranging from 65 F to zero.



Hot water convertor chart was made showing what water temp in pump should be for outside temp

Although the adjuster now seldom needs to be changed, and then only a hair, a reading is taken once or twice a day of the outside temperature and of the water temperature in the pump and compared to the chart.

It is no longer necessary to check thermometers in offices several times daily because of demands for temperature changes.

* Hersey Manufacturing Co, Dedham, Mass.

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For boiler pressures up to 1050 psig.
Vision length—5 port—12⅜" and 7 port—18". Longer vision lengths easily obtained by adding 18" or 12⅜" sections for necessary length.

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
STEAM SHOWS RED
WATER SHOWS GREEN
COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
EACH PORT THERMALLY INDEPENDENT

MODEL MP-3000 MULTI-PORT
For boiler pressures up to 3000 psig.

Note These Features:

- **Less Maintenance — Greater Availability — Ports seldom need changing.**
- **Thermal Stability — Warm-up in minutes instead of hours.**
- **Ports are 1⅛" diameter on MP 1050 Gauge.**
- **Gauge body machined from a solid block of stainless steel. Welded tube and flange connections.**
- **"Hi-Lite" Illuminator — More visibility with less cleaning.**

The individual glass disks provide inherent thermal stability not obtained in the continuous vision gauge which requires the long glass and mica. Thermal stress is much less troublesome and damaging. Small mica disks cost less, and are not subject to wrinkling or cracking. Any port — glass, gasket and mica — may be replaced in minutes without removing the gauge from the boiler. Torquing operations are much less critical, and warm-up period is minutes instead of hours.

The Bi-Color feature makes reading sure. By an invariable optical principle, steam always shows red, water green. Changes in level show instantly. 8302

For a trouble-free gauge that makes reading of water level sure and easy — Diamond Multi-Port Bi-Color —

Write for

Bulletin 2044-A for pressures up to 1050 psig
Bulletin 1174 for pressures up to 3000 psig

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED • Windsor, Ontario

For more data circle 551 on Post Card

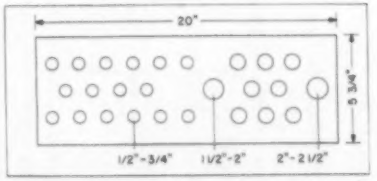
Beefing Up the Electrical Cabinet Top

By PAUL C. ZIEMKE

WHILE the electrical manufacturers are in accord on standards for their equipment, thus achieving a degree of uniformity in the field, there must remain a host of situations where the dimensions do not apply.

The layout shown in the sketch is typical of the 6 by 20-in. 230-115 volt lighting panel knockout plan for the top and bottom sections. Frequently, the journeyman must deviate from this plan, as conduit sizes other than those intended are to be used for protecting the home run wires. This means the layout of a new set of knockout conduit holes which must of necessity overlap those provided by the factory. This new layout is hard on the thin-webbed stock of the cabinet, and all too frequently it happens that as lock nuts are driven tight, the sharp edges rip up the weakened hole extremities of the original knockouts.

This somewhat mutilated cabinet top is not only structurally weak, but also is the ready victim of rust from moisture and any corrosives.



Knockout layout typical of the 6 by 20-in. 230-115-v lighting panel, top and bottom sections

Confronted with this problem in the early stages of operation in the chemical sections of atomic plants, construction plans were altered to require the reinforcing of the panel tops by the proper sized section of 1/16-in. sheet stock having ¼-in. overlap on right angles, to shed moisture. Galvanized bolts were used to fasten the new top at the corners.

Thus reinforced, the new and larger-sized knockout layout was then scribed and cut to suit the new conditions.

Present day journeymen save aluminum scrap sheet for just such reinforcing.

Don't Forget to Check Those Steam Collectors!

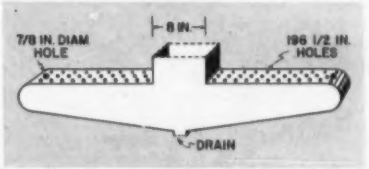
By JAMES M. CURRAN

OUR 150-LB pressure water-tube boilers were blowing off three and four times per shift, for no apparent reason. The safety valves were overhauled and new rings were installed on the dashpot of the main stop valve, but we had the same trouble as before.

Every summer the boilers are overhauled completely, but the last item that is inspected is the steam collector. It is connected to the steam drum by two bolts at each end. Only way to check it, without removing it, is by hand. When this was done, we discovered that some of the holes were not clear. The steam collectors were taken off both boilers, and 75 per cent of the holes were found to be plugged.

When the load went up in the boiler, the blocked holes prevented the steam from escaping fast enough, and the safety valves blew.

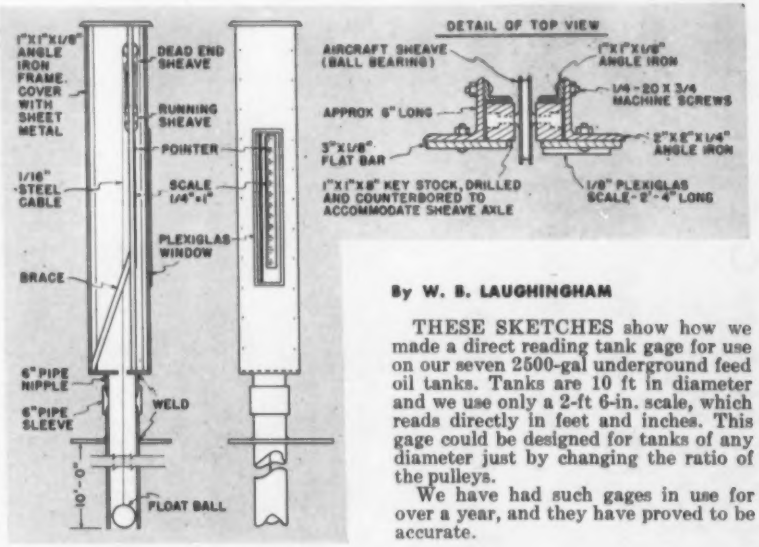
A dry pipe in an hrt boiler is quite accessible, as it is usually located near the manhole in the top of the boiler; but this is not the case with a steam collector in a water-tube boiler.



Schematic of steam collector. There are 386.9 sq in. in the 196 holes, 50.27 sq in. in the 8-in. outlet. Ratio is 386.9 divided by 50.27, or 7.7

fold along this line—outside edges toward you

How to Make a Liquid Level Gage For Use on Oil Tanks



By W. B. LAUGHINGHAM

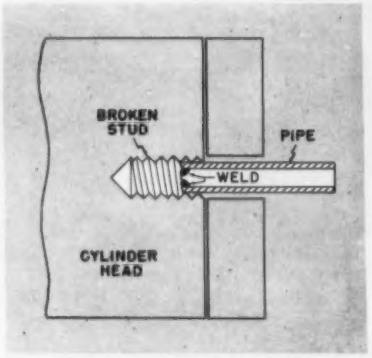
THESE SKETCHES show how we made a direct reading tank gage for use on our seven 2500-gal underground feed oil tanks. Tanks are 10 ft in diameter and we use only a 2-ft 6-in. scale, which reads directly in feet and inches. This gage could be designed for tanks of any diameter just by changing the ratio of the pulleys.

We have had such gages in use for over a year, and they have proved to be accurate.

How to Remove a Broken Stud

By RALPH M. ANDERSON

WE HAD TO REMOVE a hard-to-get-at stud bolt which was on the crank end of a large compressor cylinder head. The stud was broken about 5 in. below the surface. We inserted a piece of 1-in. pipe into the hole, and welded the broken stud to the inside of the pipe. A few light taps of a hammer loosened it, and then a pipe wrench was used to back the stud out.



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EQUIPMENT NEWS

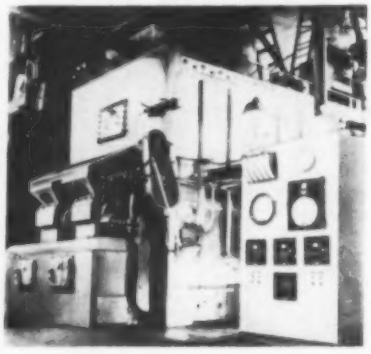
Reader Service Cards on pages 117–118 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

1—STATIONARY BATTERIES are lightweight, space saving

Available over a wide capacity range — 50 to 1140 amp hr — this new line of Kathanode batteries is designed for full float service. A rugged Plastrite jar, lighter in weight than conventional containers, is said to save 30 to 40 per cent of floor space, permit increased battery room capacity and reduce storage rack requirements. Construction improvements announced include a leak-proof post seal utilizing a soft rubber O-ring in compression to seal the post against seepage; the acid proof seal serves to eliminate corrosion and wet covers. Breakage of plastic cover due to weight of battery elements is claimed eliminated due to an integral molded ledge on each end of the jars that supports all element weight. Elements are prevented from shifting, even though a cell may be accidentally inverted, since the U-shaped plastic support is bonded to the jar edge. Gould-National Batteries, Inc.

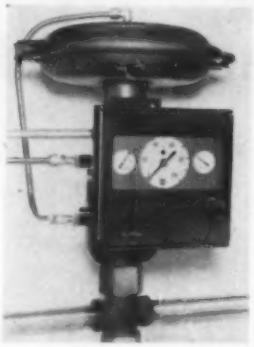
2—STEAM GENERATORS are coal fired packaged units

This line of generators affords an economic choice of packaged steam and power supply in coal fired units of substantial capacity. They are available in standard sizes of 43,000, 50,000 and 63,000 lb of steam per hour with pressures to 250 psi. One of the water-tube units now under test is reported to have operated continuously at 54,000 lb per hour with efficiencies of more than 80 per cent. Advantages announced include flexibility, smokeless operation, variety of fuels, semi-automatic operation, and changeover from coal to oil in 7 hr. Bulletin PG-59-4 gives performance data. Foster-Wheeler Corp.



3—INSTRUMENT serves as controller, valve positioner

The Pilot Positioner is designed to combine — in one relatively low-cost, valve-mounted unit — functions of an indicating pneumatic controller for temperature or pressure, and a "valve positioner" which amplifies air power for positioning of a pneumatic-operated control valve. By being close to the process and to the valve it controls, the Pilot-Positioner minimizes transmission



lags, it is pointed out. It can be mounted on many makes of diaphragm motor valves, or certain types of pneumatic operators and requires only one air supply.

Applications are expected to be primarily in the process and power industries, where valve may stick because of built-up deposits on the seat, where valve stem is subject to friction, where large unbalanced forces act on valve stem because of fluid pressure on the plug area of a single-seated valve. It is also suggested for use where a valve should respond to small changes in controller output air pressure, where a valve should respond rapidly, and where smaller valve topworks offer significant saving. U. S. Gauge Div., American Machine & Metals, Inc.

4—COAL CONVEYOR designed to clear jams automatically

This self-clearing coal conveyor has a two-way, switch-controlled motor drive to make it possible to eject obstructions simply by reversing coal screw rotation. Coal screws and flanged coal screw housings are made in matched sections and can be assembled to operate at any angle, with single or dual discharge chutes. Conveyors can be specified for horizontal cross feed tandem or vertical operation. Standard capacity is 2,500 lb per hour, based on 48 lb coal. Bulletin W-316 gives details. The Will-Burt Co.

5—WOUND ROTOR MOTOR in high speed ratings

High speed wound rotor vertical motors with a wide range of enclosures are offered in 150 hp and up, frames 584 and larger. For applications requiring high starting and accelerating torques with low inrush current, or adjustable speed control, the wound rotor verticals are said to offer features of large heavy duty induction motor design. Rotor and stator cores are notched for accurate alignment. Coil extensions are kept as short as possible and anchored to an insulated steel ring to prevent coil movement. The slip ring assembly, built and balanced as a separate unit, is partially spanned by the brush holder assembly which can be removed as an independent unit for inspection and servicing. The Ideal Electric and Mfg. Co.

6—OVERTEMPERATURE RELAY for variety of a-c applications

This direct monitoring overtemperature relay device consists of a magnetic relay, two transistor amplifiers, a diode network for signal separation and a voltage regulated power supply. Designed to protect three-phase a-c motors, this relay is reported suitable for use wherever overtemperature is a problem. It permits use of equipment without danger of over-heating, it is stated, because the component responds only to actual temperature of the protected equipment. This is because the thermistor is inserted in the windings of the motor, generator or transformer. Power supply ratings are 110, 208/220, 440 or 550 v, 60 cycles. Contacts are the pilot duty type, 600 v a-c. Cutler-Hammer Inc.

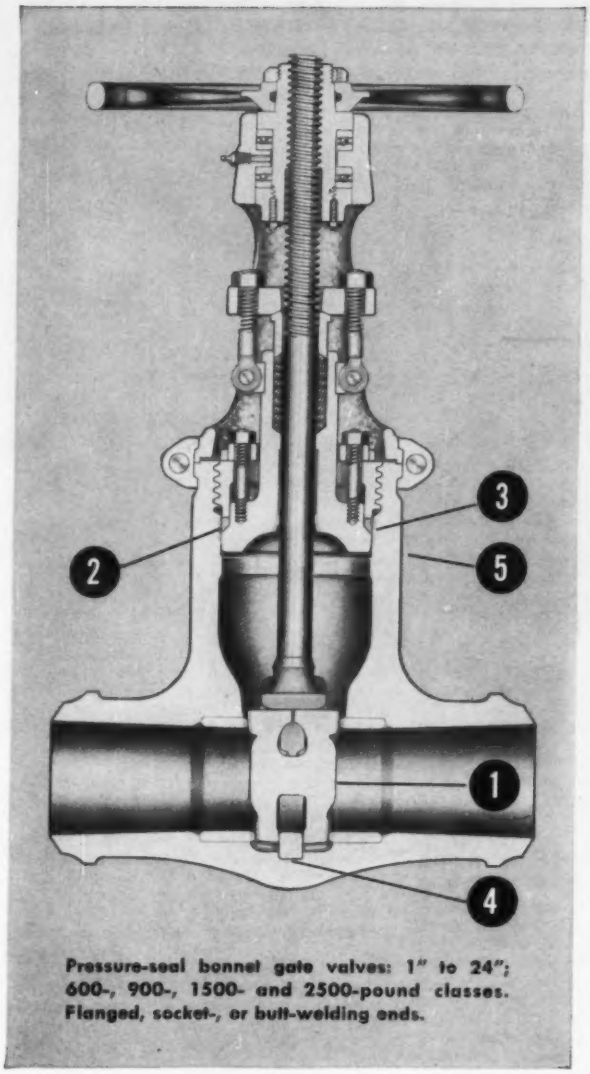
7—POWER CABLE is insulated for higher voltage service

This 28-kv power cable with 33/64-in. thick butyl-rubber insulation is introduced as an answer to higher voltage requirements. In addition to its heavy

insulation, the cable has a 7/64-in. Neoprene outer jacket, an outside diameter of 2.3 in. and weighs 3.6 lb per ft. The cable has been tested at 120-kv a-c for 5 min and 150-kv d-c for 15 min without any evident physical or electrical deterioration, company notes. National Electric Div., H. K. Porter Co., Inc.

8—SELF-PRIMING PUMPS with choice of bearing stands

Centrifugal pumps in the AW Series are self-priming and feature a trap with readily accessible and removable strainer. This top-suction-entrance trap holds the prime. The separator below the discharge opening, is an integral part of the casing and designed so that the pump's overall height is minimized. Three types of bearing stands available, include one for medium service or average conditions, a heavier duty unit in which much of the shaft is enclosed within the bearing stand, and one with



Pressure-seal bonnet gate valves: 1" to 24"; 600-, 900-, 1500- and 2500-pound classes. Flanged, socket-, or butt-welding ends.

Note these Features

❶ Flexible wedge disc prevents sticking.

❷ One-piece, silver-plated seal ring remains freeze-free for easy dismantling.

❸ Wear-resisting stainless steel inlay prevents corrosion at this critical point.

❹ Full-length disc guides prevent wear and drag on seating surface.

❺ Design saves up to 60% of weight of bolted bonnet valves.

ALL CRANE PRESSURE-SEAL BONNET VALVES ARE ASA-RATED

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957 as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.

New globe lift-checks. Feature only two internal parts: cage-type disc and liner. 900-pound class, 3" to 12"; 1500-pound class, 2½" to 12"; butt-welding ends. Stop-checks available also.

Globe and angle valves. Globe valves of Y-pattern design in all sizes; interior areas shaped to decrease turbulence, reduce pressure drop. 1" to 16"; 1500-pound class; socket- and butt-welding ends.

Modern controls for steam stations...
Crane pressure-seal bonnet gate valves

Here is the most modern valve designed for high-pressure/high-temperature service. Bonnet joint leakage is eliminated. Weight is reduced without sacrificing strength and safety. Its streamlined contour simplifies insulation. Easy accessibility provides for quick, in-line servicing. Critical points of wear are protected by special metals. These and other advantages assure trouble-free service with minimum maintenance.

For complete facts about this gate valve and all other valves in the *expanded and improved line* of Crane valves for power plant service, see your Crane Representative.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

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a lighter bearing stand. All of these pumps have capacities to 1000 gal, heads to 125 ft, sizes from 1 to 5 in. Because of the self-priming feature these pumps can be stationed above the liquid level. They are claimed ideal for handling corrosive liquids. Form AW gives further details. Nagle Pumps, Inc.

9—REVOLVING HANDLES make hand-wheel turning easy

Made of aluminum, these handles feature an extra long bearing surface to reduce turning friction and wear, and provide additional strength. As hand-wheel is turned, the revolving handle grip spins on a steel stud attached at right angles to hand-wheel. It is attached by inserting stud at convenient location on wheel and slipping handle grip over stud. The locking ring assures positive fit, manufacturer says, and handle can be removed and reassembled. Four handle lengths range from 1 9/16 to 3 1/4 in. Jergens Tool Specialty Co.

10—SPRAY NOZZLE features long life orifice

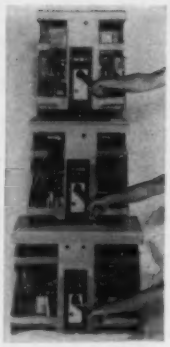
The Quik-Clamp is announced as a non-clogging spray nozzle for use wherever a pressure spray is needed. The nozzle, made of cast manganese bronze to resist abrasive wear, has a machined taper on

the outside diameter of the nozzle so that it fits snugly into the hole which has been drilled and taper-reamed in the pipe. The nozzle has a higher hydraulic efficiency than a plain hole in a header pipe, company states, and it is not necessary to replace the entire header when corrosion or wear has opened up the orifice — a bronze U-clamp and cam lock nozzle in place. Nozzles fit pipe diameters of 2, 2 1/2 and 3 in. Folder 2986 gives details. Link-Belt Co.

11—PROPORTIONING PUMP is compact, electrically driven

Proportioneers Model 1210 Chem-O-Feeder is an electrically driven, positive displacement chemical proportioning pump with corrosion-resistant transparent plastic head, Hypalon diaphragm and check valves and straight-through flow. It is designed to porportion chemical solutions, acids and alkalis to process water and for other applications where controlled feeding of chemicals is important. It comes in simplex, duplex and triplex models for adjustable, wide-range proportioning up to 36 gph with discharge pressures to 125 psi. Complete package, ready for installation, includes Chem-O-Feeder motor, suction and discharge tubing, injection nozzle, foot valve, tools, parts. Prices start around $285.00. B-I-F Industries, Inc.

12—LOW VOLTAGE POWER CIRCUIT BREAKERS utilize stored energy principle



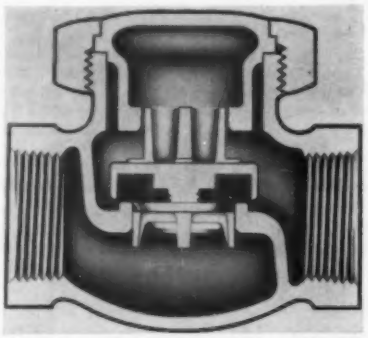
All frame sizes of this company's low voltage power circuit breakers can now be operated manually or electrically utilizing the stored energy principle. Stored-energy spring-close mechanisms are designed to provide positive constant, high-speed closing of contacts resulting in greater safety and prolonged contact life. Frame sizes, designated AK-2-50, 75 and 100, are rated 1600, 3000 and 4000 amp respectively, up to 600 v. Principal advantage noted is that the low-cost manual breakers may be used in many applications formerly requiring electrical breakers, as in selective tripping systems. They are also suggested for intermittent motor starting. Built-in maintenance features announced include individually spring loaded contacts, use of a wrist pin to carry load current, and self-aligning mechanism to reduce wear on moving parts. General Electric Co.

13—POWER, BLOWER UNITS provide job versatility

These lightweight portable power and blower units are designed for a variety of on-the-spot electric power applications, ventilation needs, and exhausting purposes. A source of electric power for lights, portable tools and other electrically driven equipment, is provided by the portable generating sets. The generators are available in two sizes — 1250 w, 115 v a-c and 1350 w, 125 v d-c. Each weighs less than 100 lb. Two types of blowers are offered — an engine driven blower and an a-c, d-c motor driven blower. They are claimed especially suited for supplying fresh air to manholes and sewers, for ejecting smoke, fumes, stale and contaminated air, etc. Each type has a rated capacity of 800 cfm. United States Motors Corps.

14—BRONZE VALVES in globe and lift check types

No. 229 C, a 200-lb bronze globe valve, and No. 239 C, a 200-lb bronze lift check valve (shown) are available in sizes from 1/4 through 2 in. They replace company's former 212 C and 218 C valves. The new models have integral body seats with a semi-crown face instead of the screwed-in seats formerly used. The disc holder



on the new globe valve is of slip-on type — no threaded disc stem ring. This disc holder speeds repair by insertion of a new composition disc or replacing of the disc holder and disc as a complete unit. The valves are regularly furnished with No. 4 Cranite discs, for high pressure steam up to 450 F. When ordered for cold water, air, gas, oil, or gasoline, the valves are furnished with a No. 6 disc, a synthetic base composition soft enough to make a tight seat on air or gas, yet resistant enough for hot water, repeated operations. Crane Co.

15—SWITCH MECHANISM combines two level stage action

Model J-1 S-1 VP Tandem Magnetrol Head combines a two level stage switching action to provide an electrical switch mechanism (S-1) in a vapor-proof and explosion-proof switch housing mounted physically over a pneumatic (J-1) switch mechanism. The head can be so set up that either electric or pneumatic action can be secured as the first stage on rising (or falling) level regardless of physical positioning of each mechanism. Using air or gas as an operating pressure medium, company's pneumatic switch mechanisms are available with many styles of actuators. The force-multiplying linkage of the pneumatic switch mechanism provides a flapper pressure against the nozzle to seal off flow of air against 0 to 30 psi in standard models, up to 100 psi where desired.

The tandem head combination is reported to enable such applications as: air-operated level control, such as spring-loaded diaphragm valve with overriding electric action at high level for high-level alarm or shutdown; air-operated level control with underriding electrical action at low level; electrical control of level (motor valve, solenoid valve or pump action) with a pneumatic high-level alarm or shutdown; electrical control with underriding pneumatic action for low-level alarm or shutdown. Magnetrol, Inc.

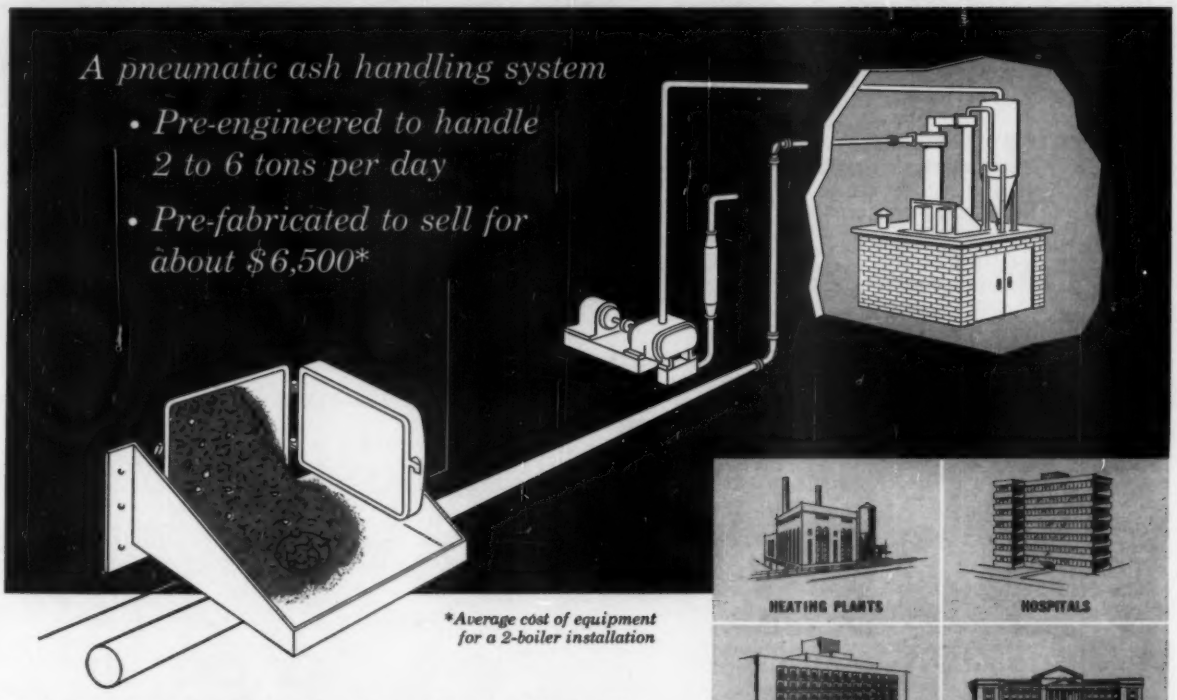
16—COAL SCALE features greater accessibility

Special feature of this 1000-lb unit capacity coal scale is greater accessibility to critical parts provided by eight access doors — two more than on standard models. These doors permit quick removal of weigh hopper and easy access to any part of the scale for inspection or adjustment, company says, and have special linings and mountings to prevent coal dust falling to floor when door is opened. Ruggedly constructed with heavy steel angles on frame and plates of heavy-gage sheet steel, it has an hourly capacity of 60 tons. Richardson Scale Co.

17—FLOW TRANSMITTER for water, sewage, industrial waste

Chronoflo In-Stream Transmitter, Model CTF-S, is for installation on Parshall flumes, weirs and other head-area devices for measuring rates of flow in open channels. This transmitter is in-stream actuated, and utilizes a float arrangement with the 6-in. expanded poly-

THE FIRST BIG BREAK IN ASH HANDLING COSTS
FOR THE SMALL COAL BURNING PLANT



**Average cost of equipment for a 2-boiler installation*

Engineers of small coal burning plants—Heating Plants, Hospitals, Hotels, Institutional Buildings, Military Installations, Municipal Power Plants, Office Buildings, Schools, Colleges, Small Industrial Plants—have long wished for a small, practical ash handling system that would eliminate much of the inconvenience, dust and constantly increasing labor costs of manual ash removal. Available ash removal systems could not be economically justified where less than 10 tons of ash per day was produced.

Aware of this need, The Allen-Sherman-Hoff Company assigned its best engineering talent to untangle the problem. The result: the *new* A-S-H ECONO-ASH System.

A major step in solving this problem was pre-engineering. Use-proved designs of major components were re-engineered to handle smaller quantities; new equipment was designed and tested. One requirement was basic: cost reduction without loss of efficiency. Installation, for example, was made so simple that it can be made with local labor.

We've prepared a 4-page brochure to explain the *new* ECONO-ASH System—how it operates, its variations and its advantages. We'll send it to you immediately upon request. It also lists the A-S-H Sales Engineers—one is near you—who will be glad to show you how, in most installations, the *Econo-Ash will pay for itself in two years or less.*

MATERIALS HANDLING SYSTEMS

the **Allen-Sherman-Hoff** company

251 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

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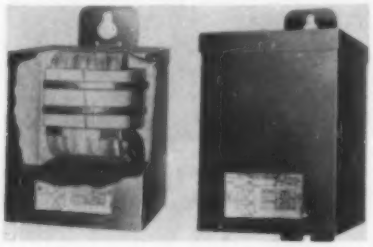
styrene float riding directly in the channel at the proper metering location. Float motion is vertical with no radial correction necessary, it is noted. Features announced for Model CTF-S include faster response to flow changes, as well as elimination of stilling wells, flushing systems, piping, and sediment tanks. Its parts are interchangeable with existing Chronoflo instruments for adopting them to this method of in-stream metering. Bulletin 230.20A-3 gives details. B-I-F Industries, Inc.

18—TRANSFORMERS are dry-type, small size units

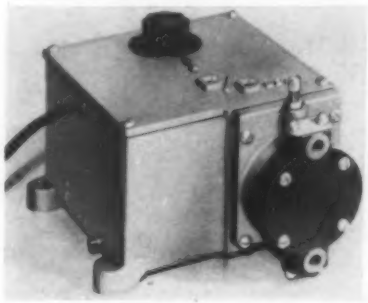
Quiet operation and small size are announced for these epoxy compound filled dry-type distribution transformers. They are built in single-phase ratings 1 through 10 kva, 600 v and below. The wound-core Form W ele-



ment is placed in its steel enclosure and covered with liquid epoxy resin to which filler and catalyst have been added. As the resin cures, it hardens into a block of insulating material, encasing the core and coil assembly and protecting it against dust, moisture, corrosive fumes. Use of the sound-deadening insulation eliminates need for metal framework and subassemblies. Light in weight, these transformers require no fireproof vaults, it is noted; they mount in any position, on wall, floor, ceiling. Wagner Electric Corp.

19—METERING PUMP for corrosive and non-corrosive liquids

This controlled capacity chemical metering pump, a diaphragm pump designed for positive displacement metering of a wide range of liquids, is said to satisfy requirements of accuracy, low

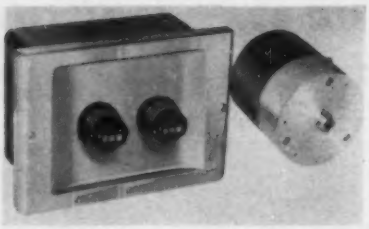


flow metering with four flow ranges available up to 2.5 gph. Hydraulically balanced Teflon diaphragm is used to eliminate flexing fatigue and distortion of flow rate. Pump operates against back pressures to 500 psi and wetted parts can be constructed of many materials such as plastic, stainless steel, nickel, etc. Clark-Cooper Co.

20—ELECTRONIC SWITCH senses and limits position, level

Designed to sense and remotely limit position, weight, level or pressure, this electronic limit switch is introduced for applications where one or more trip points must be frequently reset as in sequencing and programming. Limits are set to accuracies of ½ of 1 percent for standard units, it is stated, or to one part in 250,000 for special systems. This switch is used for setting trip points on batch weighing scales or load cells, adjusting pressure limiting devices, other position or load limiting functions. Component and installation costs are claimed low, particularly for applications where several trip points are to be set, where reset is frequent, and where high accuracy is required.

There are two components: setter and sensor. One or more limit points are set in on individual dials or counters of the setter (shown left). Each dial sets a potentiometer or resistor which serves



in one leg of a bridge circuit. The sensor varies a resistance in the other leg of this circuit. Usually a matching potentiometer, the sensor may be any resistance varying transducer. A frequently used sensor is the shaft mounted unit (shown at right) which includes built-in potentiometer and gear trains. The setter circuit consists of a transistorized bridge-amplifier on a printed circuit board and enclosed in a steel cabinet. The Jordan Co., Inc.

21—SPEED REDUCERS are 25:1 double reduction units

Shaft-mounted speed reducers in the Torque-Arm line now include a 25:1 double reduction series in eight sizes. Design improvements in the double reduction units have not changed overall dimensions or horsepower ratings. Both 15:1 and 25:1 gear ratios are available in housings of identical dimensions and at same prices. Output speeds range from 12 to 400 rpm. Giant of the series is Size TD11, described as the world's largest shaft-mounted reducer offered from stock. Its reduction ratio is 24.73:1 and it is rated at 154 hp at 75 rpm.

In redesigning these reducers, manufacturer has utilized an improved method of attaching the torque arm to the reducer case, employing a saddle-type bracket for strength and better balance. It is noted that while the 15:1 reducers are suitable for most applications, the new 25:1 units give 40 per cent lower output speeds with identical motor speeds and V-drive ratios. When output speeds are the same, lower ratio V-drives may be used with the 25:1 units at lower cost. Bulletin A692 gives detailed information. Dodge Mfg. Corp.

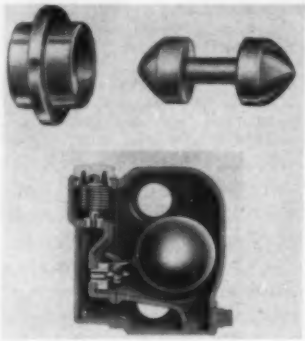
22—FELT INSULATORS in wide range of densities

For high temperature industrial equipment, refrigeration systems etc., B-E-H Spun Felts come in densities from 3 to 8 lb per cubic foot and with a variety of surface facings. Made from spun mineral fibers with a phenolic resin binder, B-E-H Spun Felts can be used to insulate surfaces having temperatures from below zero to 450 F. If mechanically supported and enclosed, they may be used to 600 F. Lightweight and resilient, the material is claimed incombustible, non-corrosive and moisture resistant. It can be cut with knife or saw.

In the lower densities, this insulation is flexible. Those of 4 lb and higher are semi-rigid. Coatings include black Kraft vapor barrier paper, Kraft paper and asphalt laminate, scrim reinforced aluminum foil laminated with flame-proofed Kraft paper, aluminum pigmented vinyl film, embossed aluminum foil. Higher density types are also available with Neoprene coating. Thicknesses are 1 to 4 in. Baldwin-Ehret-Hill, Inc.

23—STEAM TRAP features an improved float lever

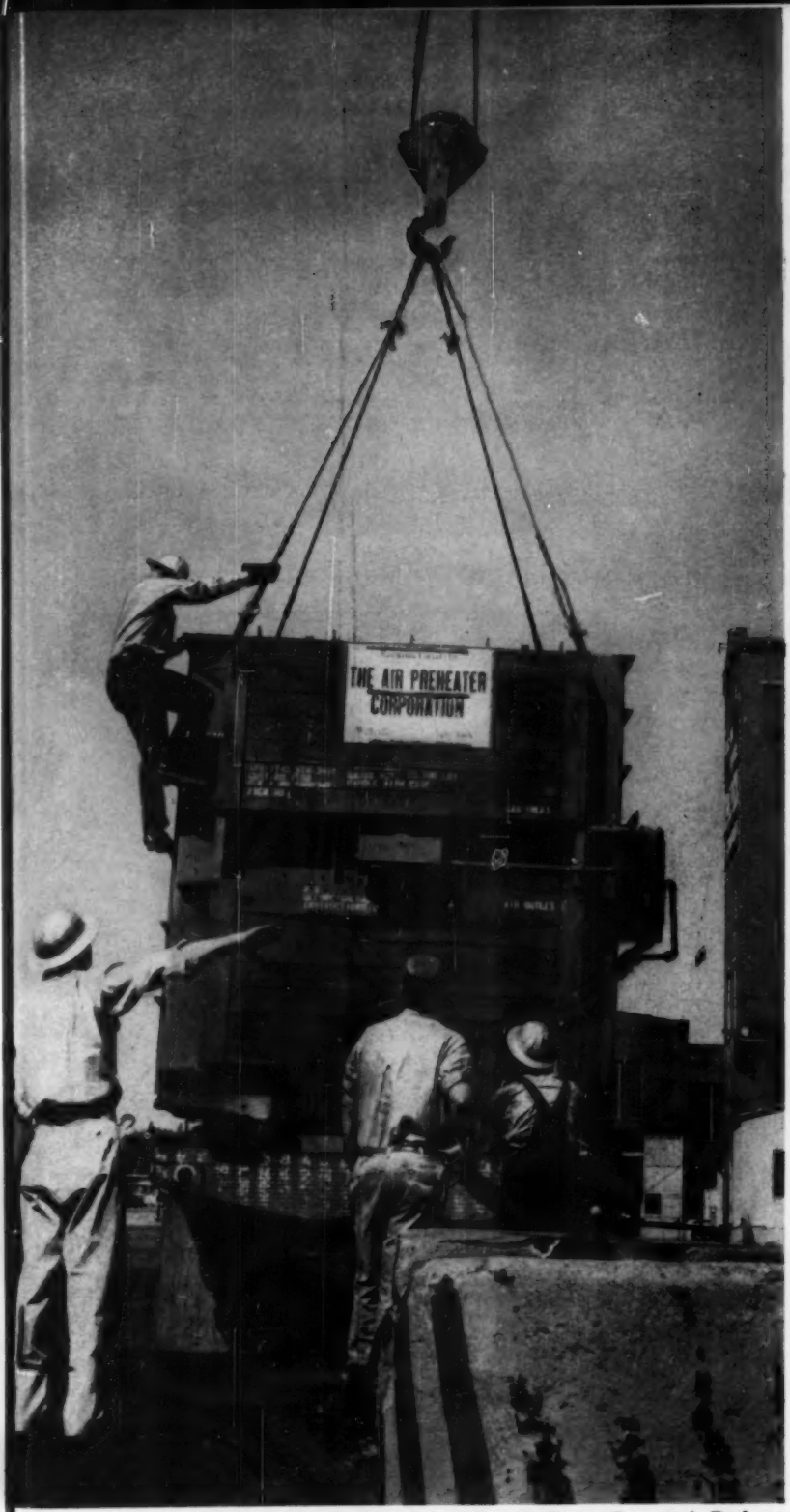
The float lever in L-R-P Steam Traps is designed to provide balance for more sensitivity and assure precise operation at any pressures from 0 to rated capacity. Double life without parts replacement is claimed to be provided by the



reversible valve and valve seat. Since all working parts are contained in the cover assembly it is not necessary to break pipe connections for maintenance work, company states. The traps come in two types: Type T with float and thermostat for vacuum and pressure service; Type M, float only, for pressure operation. Traps are available in sizes up to 125 lb water pressure. Bulletin 500 gives details. L-R-P, Inc.

24—DATA PLOTTING BOARDS take d-c analog signal inputs

Two analog data plotting boards, MC-3301 and MC-3302, are designed to plot one d-c signal, or two signals simultaneously, on a 30-by-30 surface. Model MC-3301 is equipped with one arm-pen assembly, Model MC-3302, with two. These transistorized units are said to provide features most often required in plotting data from digital and analog computers. The board consists of plotting assembly and control panel and may be utilized with plotting surface in any position desired from horizontal to vertical. The control panel may be located adjacent to plotting surface or remotely. Electroluminescent back il-



Compact and completely pre-assembled, Inland Empire Paper Company's Package Air Preheater is ready to be connected to a 100,000 lb/hr boiler. This particular Package Air Preheater (incidentally a repeat order), measures approximately 10'x10'x8', and its 7000 square feet of effective heating surface will recover about 360° F. from the stack gas. Package design cuts installation time and costs drastically.

Here's why
Inland Empire Paper Co.
chose a

PACKAGE AIR PREHEATER

BIG INSTALLATION SAVINGS — AND FUEL SAVINGS THAT CAN PAY FOR THE AIR PREHEATER WITHIN TWO YEARS.

Inland Empire Paper Company, Millwood, Wash., makes these big savings with their Package Air Preheater:

1. Low-cost installation. That single unit on the truck is a *complete* Package Air Preheater. Once in place, and the ducts and power line hooked up, it will be ready to go—installed without erection in a fraction of the time required for conventional units.

2. Short-term write-off. Records of Package Air Preheaters operating all over the country prove that Inland Empire's Package unit can pay for itself in two years, just on fuel savings alone!

You get this double advantage with the Package Air Preheater because it's completely shop-assembled. And its compact design brings all the advantages of continuous regenerative heat recovery to boilers as small as 25,000 lbs of steam per hr—or as large as 250,000 lbs per hr.

There are other important advantages, too. Get the whole story by writing today for your free 14-page booklet with all the facts and figures.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

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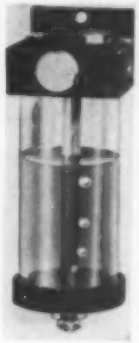
lumination provided is diffused.

Plotting surface is available in multiples of the standard 30-by-30 in. board — 60-by-60, 30-by-150 in. etc. Equipped with 400-cycle plug-in servo amplifiers and plug-in power supplies, these boards can receive input from two or four channels of analog input data. Pens plot at a speed of 30 in. per second, with maximum accelerations of 250 in./sec/sec in the X (arm) direction, of 1000 in./sec/sec in the Y (pen) direction. When plotting pens approach each other, input signals are interchanged automatically. Computer Systems, Inc.

25—SIGHT FEED BUBBLER has built-in check valve

This sight feed bubbler is for controlling and visually indicating relatively small rates of flow in gas and air lines. Typical uses include bleeding air into lines to purge them of corrosive fumes or gases, and use with hydrostatic liquid level gages hooked up for continuous gaging. The flow of gas is passed through liquid in a transparent cylinder, and the rate of flow is shown by bubbles rising through the liquid. A needle valve at top provides adjustment of flow from less than 1 bubble per second to about 20 cu ft per hour. Water, glycerine or other noncorrosive liquid may be used. A check valve in the dip tube keeps liquid from being forced up the tube and out of the bubbler when the back pressure is greater than input pressure. Data are in Bulletin 3285. King Engineering Corp.



26—ELECTRONIC CONTROLLER for solution concentrations

Designed for controlling concentration of caustic, acidic or aqueous solutions, this controller can be used with either continuous or batch-type metal washing equipment, plating processes, chemical process systems, textile bath equipment, etc. System consists of a concentrate-level setting control, a sensing electrode which measures change in concentration, a magnetic amplifier utilizing a sensing electrode to control operations of a pump assembly which delivers concentrated solution to a wash tank, and a combination compound and concentrate holding tank. In operation, whenever concentrate level falls below preset point, pump is automatically actuated and sprays a wash solution on the dry compound (or concentrate) until level is reached. Electro Mechanisms Corp.

27—BALL PEN INK for use in recording instruments

Compounded especially for ball-pen application to recording instruments, this ink is claimed to eliminate impurities or air bubbles — causes of poor pen performance. Other advantages announced are instant starting after long idle periods, operation at high ambient temperatures, light point pressure, good photocopying characteristics and good high or low chart speed performance. It comes in a choice of colors. Formulabs, Inc.

28—MASTER CONTROLLER proportions to load demand

For automatic combustion control systems or comparable industrial applications, this is an automatic, heavy-duty sensing and controlling instrument, responsive to minute changes in pressure or temperature, and transmitting line voltage signals to other system components for control of firing rate, damper positioning valving, etc. With it, firing rate and other process functions are modulated in proportion to load demands. By means of bellows or other sensing elements, pressure or temperature changes are caused to react on balancing switches. Signals are transmitted to other controllers and actuators for continuous re-positioning and regulation to maintain control set point, and signals are transmitted electrically.

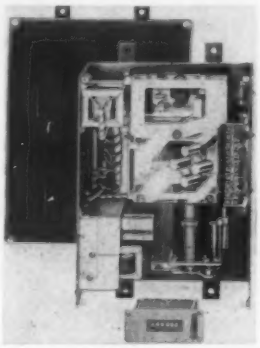
This controller utilizes a heavy duty gearhead motor, snap action switches, interchangeable plug-in relays and has adjustable compensator for proportional band. Signal lights are provided to indicate control at rest, moving toward "increase" or "decrease," or either extreme position limit. External toggle-type switches are provided for manual "increase" and "decrease" jogging. Models for controlling steam pressure come in ranges of 0 to 30, 20 to 100, and 75 to 300 psi. Cleveland Controls, Inc.

29—CIRCLES TEMPLATE is based on metric system

No. 240 Metric Circles Template is offered both as a working tool for those using the metric system, and as a basis of measurement and comparison with the English system for those not familiar with metric dimensions. Of plastic, the template contains 37 circles from 2 to 30 mm in diameter. It costs around $1.00. Rapidesign, Inc.

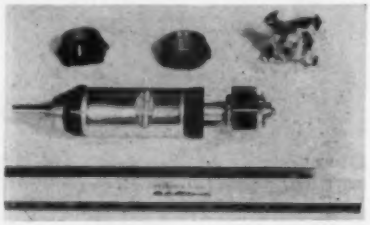
30—INTEGRATOR-COMPUTER totalizes flow from signal

The panel-mounted C3A/1 Square Root Integrator-Computer is introduced for flow measuring systems requiring a digital readout of totalized flow. It consists of two separately housed assemblies: computer package and electromagnetic six-digit indicator. The compact indicator is located remotely from the computer. Intended primarily for use in manufacturer's Autronic (R) Control Systems, the C3A/1 is installed in parallel with a flow indicator, recorder and/or controller; it operates from a common 0 to 0.5 v a-c signal and has no effect on the control loop. Normal counting rate is 20,000 counts per day, but it can be varied — by changing gear arrangement — to produce from 4000 to 100,000 counts per day. Digital totalization is continuous and accurate from 1 to 100 per cent of input signal, manufacturer states. Specification Sheet A-807 gives information. Swartwout Co.



31—TUBE REAMER simplifies cleaning operation

The Viking Jet-Air Tube Reamer, for simplified cleaning of boiler fire tubes, is claimed to cut tube cleaning time in half and make it a one-man operation. The reamer comes in five models for tube sizes from 2½ to 4 in. in diameter. Adapter sets are available for converting one reamer to another size tube. Air activated, the reamer motor centrifugally expands four hardened steel cutters that scrape deposits from tube walls. Exhaust air blows scale and soot ahead of the reamer, away from operator. Reamer is supplied with air hose and a foot control on-off valve. Plibrico Co.



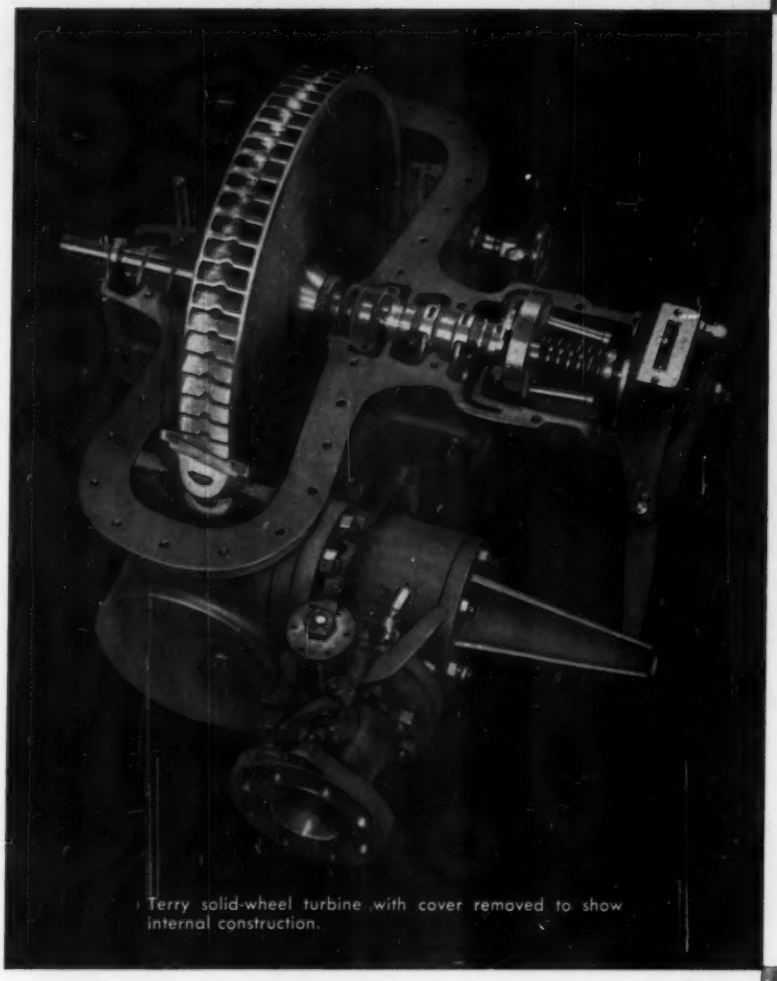
32—SAFETY SWITCHES for heavy duty applications

Rated from 400 through 1200 amp, and having a 100,000-amp interrupting capacity when current limiting fuses are inserted, QMQB Safety Switches are announced as offering safe fuse protection at economical cost. Essentially these switches are manually operated circuit interrupters employing a circuit breaker type mechanism in conjunction with fuses. Standard quick-make, quick-break contact-operating mechanism of circuit breakers are used, omitting the conventional thermal-magnetic trip unit, and a set of fuse holders is added. These holders are designed to accept standard N.E.C. fuses or current limiting fuses.

Switches rated at 400 or 600 amp are normally assembled to take single fuses; 800-amp units to take parallel 400-amp fuses, and the 1200-amp units, parallel 600-amp fuses. A feature announced for these switches is teaseproof operation. Federal Pacific Electric Co.

TERRY SOLID-WHEEL TURBINE

spells service continuity for mechanical drives



Terry solid-wheel turbine with cover removed to show internal construction.

For mechanical-drive applications, such as these, you will never find the equal of Terry solid-wheel turbines for built-in dependability. They are *designed* for trouble-free operation under the toughest service requirements.

The wheel, for example, is a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out. The blades can't foul since they are double-rim protected...with one-inch clearances at either side.

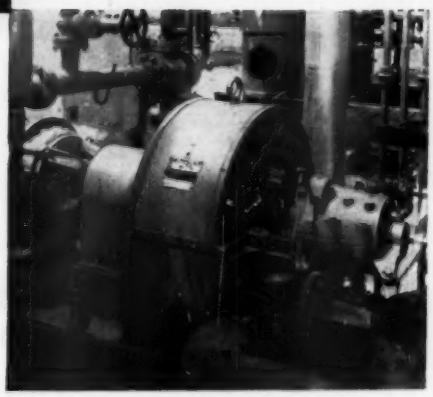
Any blade wear, which might occur after years of service, is of little consequence. As the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets, wear does not materially affect horsepower or efficiency.

Specify Terry solid-wheel turbines for your next mechanical drives. They are available in capacities from 5 to 2,000 hp., speeds up to 10,000 rpm. Vertical turbines are built in sizes from 5 to 300 hp.

For full information about these reliable turbines, send for bulletin S-116.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



TT-1216

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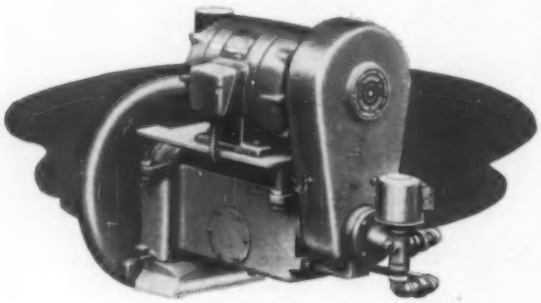
ALL PACKAGED BOILERS ARE NOT THE SAME

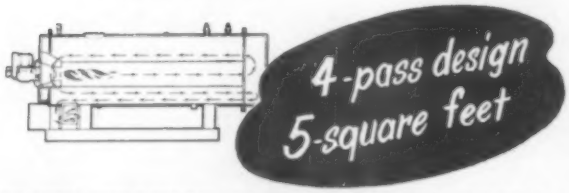
IS IT A TRUE PACKAGE ?

Superior Packaged Boilers are complete . . . including burner, draft equipment, controls and all interconnecting piping and wiring. Completely factory assembled, and fire-tested at the factory before shipment.



IS IT ROTARY-BURNER EQUIPPED ?

This is important for fully-automatic operation. The Superior Burner is capable of starting a cold boiler without compressed air, requires a minimum of supervision, and no lubrication whatsoever.



IS ITS HEATING SURFACE ADEQUATE ?

Most boilers have adequate heating surface when new. Its effectiveness is lessened, however, as the boiler is used. To insure against this, look for a full five square ft. per boiler horsepower, and Superior's 4-pass, down-draft design.

CHECK THESE IMPORTANT FEATURES

before you buy...

There's a big difference in package boilers, that is not always obvious from external appearances. In the first place, many of the so-called packages are not packages at all, but combinations of boiler on the one hand and a burner-draft-control package on the other, shipped from separate manufacturers and assembled as a unit at the installation site.

Even in the true packages there are important differences in burner equipment, draft arrangements, and in the actual rating of the boiler itself.

Superior Packaged boilers are true packages, fully assembled and fire-tested at the factory before shipment. They are equipped with dependable Superior Rotary Burners, induced draft, integrated controls, and all interconnecting piping and wiring. They are conservatively rated, based on a full 5 sq. ft. of heating surface per boiler horsepower.

The location of the furnace within the boiler shell is carefully planned to provide protection against both low-water and mud-buildup failures.

Ask your engineer about Superior Packaged Boilers, his counsel is your best assurance of a boiler which will provide years of dependable operation at high efficiencies.

Type C Superior Packaged Boilers are manufactured in fourteen sizes, from 20 to 350 bhp., and with slight design modifications to 600 bhp. Sizes above 350 bhp. are designated as Type CF. All sizes are fully automatic firing oil, gas or both, and for pressures to 250 psi. Hot water units are also available. For complete information write giving capacity range desired, and ask for bulletin 12C.

Specialists in PACKAGED BOILERS... exclusively

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SUPERIOR PACKAGED BOILERS

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INSTRUMENTS, CONTROLS

201 Metering, Control Systems — Bulletin 500 describes purpose, design and operation of company's metering and control systems. Includes discussion and pneumatic and electric telemetering and pneumatic control, along with detailed literature references. Bailey Meter Co.

202 Guide to Gages — Catalog 300-B, 112 pp, features Ashcroft, Dura-gauges, Maxisafe, pneumatic receiver, recording, quality, drawn case, chemical and special application gages. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in. Manning, Maxwell & Moore, Inc.

203 Gages, Needle Valves — Catalog 76-G consists of a loose-leaf bound collection of literature on gages and needle valves. Various types of gages are illustrated and described, with applications and specifications fully detailed. A section covers accessories. Jas. P. Marsh Corp.

204 Automatic Data Systems — Described in Bulletin MSP-154 are electronic data handling systems for logging, monitoring, and integration of process information. Discusses basic design parameters, programming, switching, analog to digital conversion, linearization, calibration, digital ranging, print-out and off-normal alarms, remote switching, digital variable indication, integration, computation. Hagan Chemicals & Controls, Inc.

205 Instruments and Controls — Catalog 57-6 describes instruments and controls, including flow meters, liquid level or pressure gage, CO_2 meters, boiler meters, pneumatic transmitters, strip chart recorder, pressure, vacuum and differential recorders, temperature recorder, multipoint gages and others. Includes descriptive data. Republic Flow Meters Co.

206 Water Columns, Gages — Featured in Bulletin 516B are boiler water columns and gage equipment. Illustrates and describes water columns for all pressures, as well as remote reading gages, liquid level alarms, water gage illumination equipment, and electrode-type liquid level alarms. Reliance Gauge Column Co.

207 Pressure Gages — Featured in 46-pp Catalog 1000G is a line of pressure indicating and vacuum gages for a variety of industrial, chemical, and refinery applications. Selector tables give detailed data on various gages and recommended service applications. Specifications, standard graduation tables, photos and dimensional diagrams are included. J. E. Lonergan Co.

208 Feedwater Regulator — Bulletin 1044 describes a feedwater regulator

NOVEMBER, 1959

NOTE: Card void after February 28, 1960

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.....Title.....

Company Name..... (Must be included)

Company Address.....

City.....State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

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designed for boilers carrying reasonably steady loads at steam pressures from 10 to 785 psig. Specifications are included, as well as flow diagram and cutaway views showing details of operation and design. Copes-Vulcan Div., Blaw-Knox Co.

209 Industrial pH Equipment — Eight-pp Bulletin 5400 gives detailed descriptions and specifications for industrial pH instruments, electrodes and accessories manufactured by the company. Brochure is profusely illustrated with photos and detailed drawings. Process Instruments Div., Beckman Instruments, Inc.

210 Oil Leak Detection — Eight-pp illustrated Bulletin 80, on the Paraprobe oil leak detection system for steam-type fuel oil heaters, gives a detailed explanation of the operation of the system. Provides installation diagrams, standard specifications, explains determination of condensate flow rate. Davis Engineering Corp.

211 Ion-Exchange Controls — Bulletin E-158 describes automatic control systems for ion-exchange equipment. Standards designed to assure proper performance of control units are detailed, and various elements in the control cabinets, as well as the power-operated units, are described. Specifications for electrical controls are also included. Illinois Water Treatment Co.

212 Resistance Temperature Detectors — In 8-pp Publication 3016D is described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operations, application and construction details of the resistance temperature detectors are presented. Instrument Div., Thomas A. Edison, Inc.

213 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls. Automotive and Research Div., American Chain & Cable Co., Inc.

MECHANICAL POWER TRANSMISSION

214 Worm Gear Reducers — Complete horsepower and torque data for company's worm gear units built on 2½ up to 4-in. centers are given in full-page tables in Bulletin 5018. Dimensions are diagrammed and tabulated in detail, and materials and design of interchangeable components are described. De Laval Steam Turbine Co.

215 Self-Aligning Coupling — Featured in illustrated Bulletin 273-M50 are company's self-aligning forged steel couplings designed to transmit maximum torque indefinitely. A cutaway view showing component features and tables of ratings are included. Koppers Co., Inc.

VALVES, TRAPS, AND PIPING

216 Industrial Valves — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations, describing non-return (stop check) valves, globe and

NOVEMBER, 1959

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POWER ENGINEERING

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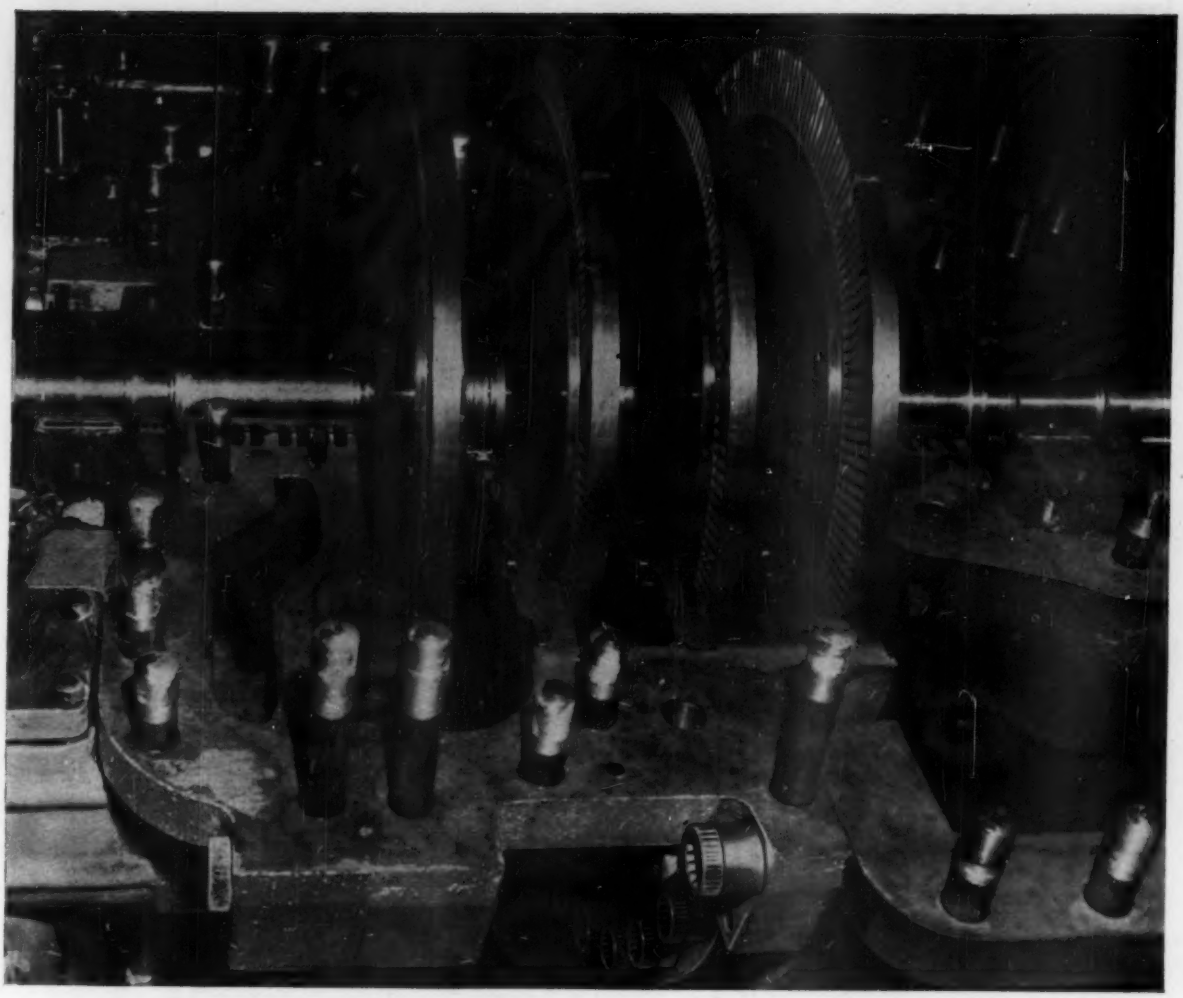

THE INSIDE STORY OF A MURRAY HIGH SPEED COMPRESSOR

DRIVE TURBINE REVEALS THE REASONS FOR MURRAY'S UNIVERSAL ACCEPTANCE

A look at MURRAY'S rugged construction from the inside shows the husky shaft and heavy accurately formed discs with generous sized hubs designed to withstand the axial and radial stresses imposed by this type of service.

Large-dimension disc rims receive the specially contoured stainless steel blades with the Murray integral shroud. This insures smooth steam passages with maximum strength.

Short bearing spans insure smooth operation and eliminate the hazard of operating in critical speeds.

A look at the heavy flanges and husky bolting in the actual unretouched shop photo shown above bears out the extreme ruggedness that typifies every feature of Murray construction.

Our nearest representative will gladly help you solve your high speed compressor drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

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Maximum Output Current 5 MA at Output Voltage up to 4 KV

PORTABLE MODEL

This newest addition to the complete Biddle line of dielectric testing equipment has been specially designed for step-voltage resistance tests, voltage withstand, and breakdown tests on the insulation of such equipment as

- **rotating electrical machinery, dry-type transformers, switchgear, capacitors and insulators rated from 230 to 500 volts**
- **traction motors and generators**
- **wiring and cable installations**

Compact portable set is housed in shock and wear resistant case for severe field use in testing reconditioned equipment after installation, as well as for preventive maintenance of installed equipment. Also available in a bench model for making acceptance and proof test on electrical insulating systems for quality control in manufacturing and repair. For complete description, specifications and prices, WRITE FOR BULLETIN 22-5-PE

- **High Maximum Output Current**
- **Suitable for Impulsing Faults**
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B911

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Laboratory & Scientific Equipment
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angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Edward Valves, Inc.

217 Forged Steel Valves — Featured in comprehensive Catalog F-10 is detailed information and engineering data on company's line of forged steel valves, fittings, flanges and unions. Includes photos and cutaway views illustrating component features as well as tables giving dimensional data. An engineering design section with complete specifications and pressure-temperature tables is included. Henry Vogt Machine Co.

218 Silent Check Valves — Described in Bulletin WH-654 are silent check valves featuring low frictional resistance. Tables list dimensional data and reasonable velocities for flow of water through pipe, fittings and valves. The Williams Gauge Co., Inc.

219 General Service Valves — Twenty-pp Bulletin E-165 is a guide to valves for general services. Types, typical applications, construction and operating features are discussed. Generously illustrated with drawings, photos and cutaways, booklet includes dimensional data. Everlasting Valve Co.

220 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

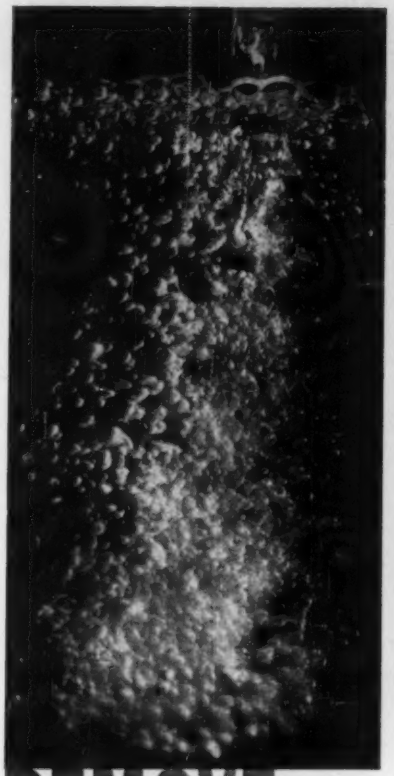
221 For Lightest Condensate Loads — Bulletin T1744 (58) describes company's No. 30 impulse steam trap for use where condensate must be handled in very small amounts. Lists advantages and applications, tells how trap works and gives capacities, dimensions, materials used, prices. Yarnall-Waring Co.

222 Steam Trap — Bulletin 257-B describes a steam trap which uses the kinetic energy of steam to close the valve. Features of trap are detailed, and dimensional data included. Sarco Co., Inc.

223 Steam Trap Book — Catalog K, 48 pp, is a manual of steam trapping practice. It includes a section giving physical data and prices on OF&T traps, cast semi-steel and forged steel inverted bucket steam traps, compound traps, ball float air and air relief traps. A handbook section explains how to calculate condensate load, and select traps for all classes of equipment; a maintenance section explains trap installation, testing, and maintenance. Armstrong Machine Works.

224 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

225 Insulated Piping — Described in 20-pp Catalog 59-1 are prefabricated insulated piping systems for underground and overhead use. Cutaway views showing design and construction features are included as well as dimensional diagrams and data, and photos of typical applications. Ric-wiL, Inc.



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DEOXY-SOL removes oxygen, reduces oxides and raises pH of the condensate all at the same time . . . yet adds no solids.

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AIRETROL pneumatic tube expansion control shown. Electric systems, including retractive units, also available.

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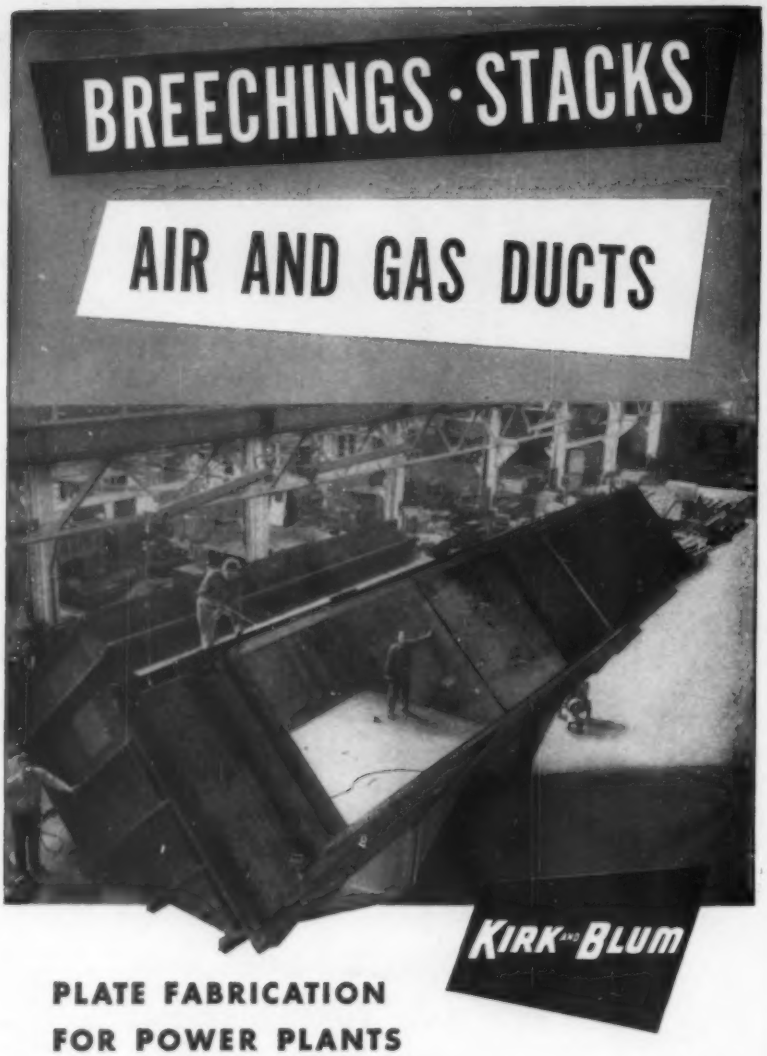

PLATE FABRICATION FOR POWER PLANTS

Whatever your requirements in fabricated plate, sheet or structurals for power plant use . . . call on experts!

Kirk & Blum has fabricated a variety of power plant needs as big as the mammoth breeching section shown here. In a 150,000 sq. ft. plant, with crane capacity to 25 tons, Kirk & Blum has complete facilities to produce, preassemble and load the largest fabrication. Kirk & Blum has the men, materials and experience to do the job quickly and economically.

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226 Flexible Hose, Bellows — Sixteen-pp Catalog 187 describes applications and use of flexible metal hose and bellows. Engineering specifications and sizes, pressure ratings, materials and fitting attachments are included. Detailed drawings and pictures facilitate specifications of individual applications. Flexonics Corp.

ELECTRICAL EQUIPMENT

227 Synchronous Motors — Advantages of company's high speed synchronous motors are detailed in 12-pp Bulletin 501. Cutaway view illustrates component parts and details of maintenance and operation. Applications and specifications data included. The Ideal Electric & Mfg. Co.

228 Aluminum in Electrical Systems — Electrical applications of aluminum are described in this 32-pp bulletin. The report discusses current economics of choosing aluminum for a broad spectrum of electrical applications. Topics include conduit, wire and cable, bus conductor, busway, armored cables, enclosures and switchgear, lighting fixtures and accessories, and such components as reactors, transformers. Aluminum Co. of America.

229 Electrical Enclosures — Bulletin EE, 14 pp, describes company's line of sheet metal electrical enclosures and other related items for a variety of applications. Covers control desks, electrical cabinets and enclosures, power distribution and control panels, boiler, turbine generator control panels, switchgear housings, and others. The Kirk & Blum Mfg. Co.

230 Testing Instruments — Bulletin 19–58, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos of each type. James G. Biddle Co.

231 Extension Wire — Featured in this product bulletin is a line of multicouple extension wire designed to reduce thermocouple-extension wire costs. Advantages are detailed and complete specifications and prices given. Samuel Moore & Co.

Postage-free cards for ordering catalogs are on page 117. You may also use the cards to order literature mentioned in the ads.

232 Handbook on Fuses — This 12-pp booklet contains practical information on how to get safe, dependable, trouble-free electrical protection. Shows what to do when fuses blow, how to determine cause of blows, what kind of fuse to use for various circuits. Contains short history of fuses and notes on construction of fuses. Bussmann Mfg. Co.

FANS, BLOWERS

234 Mechanical Draft Fans — Bulletin FD-905, 28 pp, describes a mechanical draft and other heavy-duty fans for a variety of industrial applications. Includes basic data for proper fan selection, performance tables, design sketches, component and installation photos of many

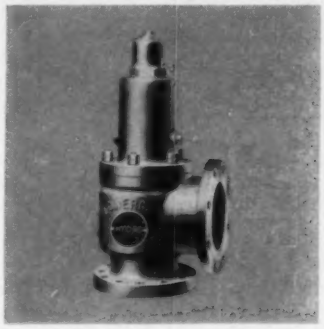
THE LONERGAN LINE

HOW TO SAVE WEAR AND TEAR ON MEN AND VALVES

by A. J. Schmidt, Chief Engineer

Power plant users of relief valves in liquid service are undoubtedly all too familiar with chattering. Valves hammer away, annoying plant personnel and running up maintenance bills.

Even with this undesirable operation, these



valves have been acceptable for application where the valves are seldom, if ever, called upon to relieve. For use under critical applications, such as pump by-pass, where the valve is normally open, or where opening is a common occurrence, it has been necessary to use expensive diaphragm or piston operated valves to eliminate objectionable chattering.

A new series of valves, called Lonergan Hydro-Valves have been under test in dozens of leading plants for the past three years. As a result, Lonergan can provide power plant operators with a valve that is guaranteed not to hammer, chatter or drum on any application, by-pass or emergency relief. At the same time, full-rated liquid flow is maintained. The chatter free operation is provided by a patented, unique design of throat, seat and baffle construction. Use of the Hydro-Valve helps to: save human nerves; prevent loss of plant fuel or product; reduce maintenance on valves and piping; and eliminate interference with delicate control systems. Hydro-Valves are available in all regular body and trim materials in sizes ranging from 1 to 8 inches.

Full details and descriptions are available in our new Hydro-Valve bulletin. Why not write for your copy today?

Alvin J. Schmidt

Lonergan

J. E. LONERGAN CO., 207 RACE STREET
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CHECK *the Advantages of* GOODALL *Rubber* EXPANSION JOINTS

Goodall Expansion Joints have not only the advantages stemming from the natural characteristics of rubber for all types of installations, but, what's more important, they have back of them Goodall's engineering skill, manufacturing experience and reputation for quality that give added assurance of exceptional service under all conditions.

EASIER TO INSTALL...

Goodall Rubber Expansion Joints are quickly, easily installed on new construction or as replacements. They are light in weight to facilitate handling, with short face-to-face dimensions for easier application where space is limited. Retaining rings are quickly aligned and bolted. No gaskets are required.

RESPONSIVE TO MINIMUM PRESSURE...

With Goodall Rubber Expansion Joints only the slightest pressure is required to create movement in any direction. Result—stress on metal pipe or other member is eliminated or, at most, reduced to an absolute minimum.

MANY SIZES...HIGH WORKING PRESSURES...

Goodall Rubber Expansion Joints are available in sizes from 3/8" to 96" I.D., in all required styles and constructions. Working pressures range up to 125 P.S.I. for Pressure Joints, and to 90 P.S.I. for Vacuum-Pressure Joints, depending on size.

LONGER SERVICE LIFE...

Goodall Rubber Expansion Joints last longer in service because of inherent characteristics of the material from which they are made. There is no embrittlement... continuous movement (flexing) actually keeps the rubber joint "alive". There is no corrosion or electrolysis. Resistance to abrasion is exceptionally high. Replacement costs are lower.

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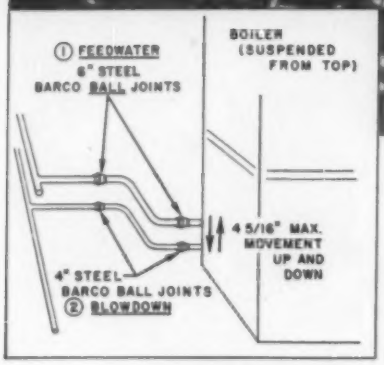
. . . where BOILERS move UP and DOWN



BARCO Ball Joints

The schematic diagram at left shows how Barco Flexible Ball Joints of steel construction are used in a new Florida utility plant—design pressure 600 psi, 500°F. The above photo shows a close-up view of two of the joints (see arrows). Two more matching joints, 4" and 6", are located out of the picture to the left. The 4" joints have metal gaskets. The same utility also uses 10" Barco joints on gas fuel lines. Other uses in power plants are for flexible connecting lines to oil burners, soot blowers, and other auxiliary equipment.

Flexible Pipe Connections!

The rapidly increasing use of Barco Flexible Ball Joints for solving piping problems in POWER PLANTS is significant for several key reasons:

1. Substantial space saving as compared to other methods in crowded piping areas.
2. Unlimited flexibility and movement. Utmost simplicity.
3. No heavy pipe anchoring required. No "end thrust" developed under pressure.
4. Ability to handle compound movement (where twisting is combined with thermal expansion and contraction).
5. Easy to engineer joints into piping to provide for any degree of flexibility, expansion, or movement required.
6. Maximum safety for high temperature applications. All-metal construction available. Special alloys can be specified.
7. Basic design is pressure sealing against leakage and self-adjusting for wear.
8. Virtually no deterioration. Able to stay in service for years without repairs or maintenance. No lubrication.

New Bulletin No. 31 contains interesting diagrams showing how to solve many common pipe expansion problems EASILY, ECONOMICALLY. *Ask for a copy;* see your nearest Barco representative or write:

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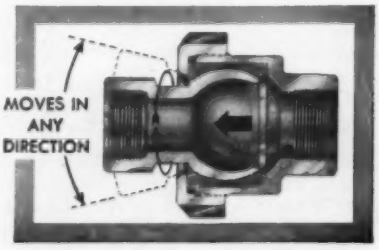
The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Rotary Joints
In Canada: The Holden Co., Ltd., Montreal



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types from kiln fans to cyclone compressors. Buffalo Forge Co.

235 Air Engineering — Bulletin E-57 is a 24-pp air engineering data file covering engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. Tables for estimating air-handling requirements, entrance and elbow losses are provided. Aerovent Fan Co., Inc.

WATER CONDITIONING

236 pH and Chlorine Control — The 14th, 1959 edition of company's handbook, "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica, nitrate, hardness. Available to qualified power engineers, please state your job title. W. A. Taylor Co.

237 Consulting Service — Advantages of company's consulting service are detailed in 8-pp Bulletin 5006-A. How the service is qualified to solve problems concerning scale and corrosion control in boilers, cooling systems, and process waters is discussed. Dearborn Chemical Co.

238 Coagulant Aids — Featured in this product bulletin is a line of coagulant aids designed to improve floc formation in clarifying and softening water. Advantages are detailed and typical applications described. Calgon Co., Div., Hagan Chemicals & Controls, Inc.

239 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. Nalco Chemical Co.

240 Boiler Water Treatment — Chemical reduction of oxygen in boiler feedwater with hydrazine is the subject of 10-pp Bulletin BW. Economy and operation, handling of the Deoxy-Sol, methods of analysis and other details are covered. A bibliography lists supplementary reading. Fairmont Chemical Co., Inc.

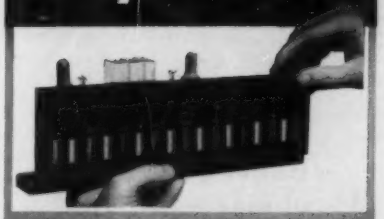
241 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and nondeaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. Stickle Steam Specialties Co.

HEAT EXCHANGERS

242 Heat Exchangers — Bulletin 132 contains detailed information on company's self-contained heat exchanger featuring sectional design. Cutaway diagram shows heat exchanger functions. Niagara Blower Co.

243 Heat Exchanger — Featured in this 12-pp bulletin is the Fin-Pak, a compact heat exchanger designed for a wide variety of fuel burning and process equipment. Structural details and operating

Easy-To-Use!

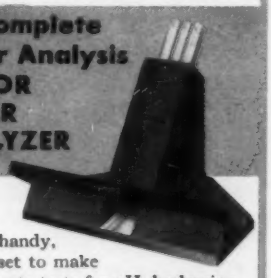


TAYLOR COMPARATORS

Let You Make Accurate pH, PHOSPHATE TESTS Anytime, Anywhere, in Minutes

Here are compact, portable test sets that give highly accurate determinations of pH, or phosphate content, yet are so simple to use that tests can be made on-the-spot in minutes. Although easy to use, they virtually eliminate mechanical error when making tests. Data are obtained simply by placing treated sample in center tube and moving color standard slide across until sample liquid matches one of the color standards. That's all there is to it. Read values directly from the slide, and you have accurate, dependable data for use in boiler, condenser or cooling tower operations. Also available—Midget Iron Testers, Total Hardness Sets, Sulfite Comparators, Nitrate Comparators. Sulfite and Nitrate color standard slides available separately for use with phosphate or pH base.

For Complete Water Analysis TAYLOR WATER ANALYZER



Use this handy, portable set to make fast, accurate tests for pH, hydrazine, silica, ammonia, total iron, nitrate, etc. Sealed-in-plastic color standards eliminate handling of delicate glass standards.

COLOR STANDARDS GUARANTEED

All Taylor liquid color standards carry an unlimited guarantee against fading. Use only Taylor reagents and accessories with Taylor Comparators to assure accurate results.

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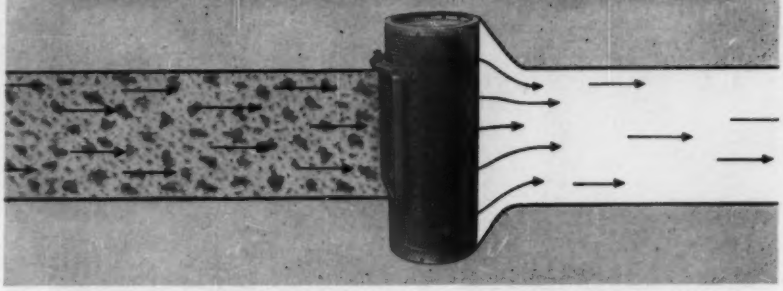
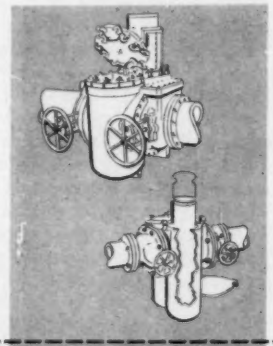
ELLIOTT STRAINERS

assure "trouble-free" clean liquids



For over 50 years, Elliott strainers have proved themselves in power and industrial plants everywhere. Removing objectionable solids that could cost thousands of dollars in lost time and damaged equipment, they keep liquids clean and free of foreign matter.

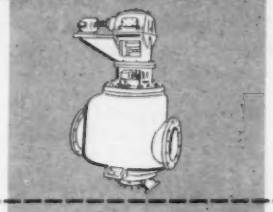


ELLIOTT TWIN STRAINERS
TYPE A, for water and other liquids

Provides continuous flow, since one strainer basket is in service while the other is removed and cleaned. Available sizes 4" to 24" for 125 psi, and 4" to 12" for 250 psi pressure. Straining-basket mesh ranges from 1/32" to 3/8". Also available: back-flushing strainers in manually-operated and rotary spray types, sizes 4" to 24".

TYPE V, for lube oil, fuel oil, viscous liquids

Uses large-size baskets to facilitate unrestricted fluid straining. Sizes from 1" to 8" for 125 psi, 1 1/2" to 10" for 300 or 500 psi, straining perforations from 3/8" down to fine wire mesh.



TYPE K SELF-CLEANING STRAINER
for removing large amounts of foreign matter in water

Cleans itself automatically and continuously by back-flushing the straining units. Standard sizes 4" to 24", pressures 25 to 125 psi, straining units 1/32" to 3/8" mesh. Available with AC or DC motor, low power requirement.

TYPE F SINGLE STRAINER
where flow can be interrupted for cleaning

Excellent for liquids not containing large amounts of foreign matter, or batch processes. Quick-opening cover. Sizes 2" to 24" for pressures up to 125 psi, basket mesh 1/32" to 3/8".

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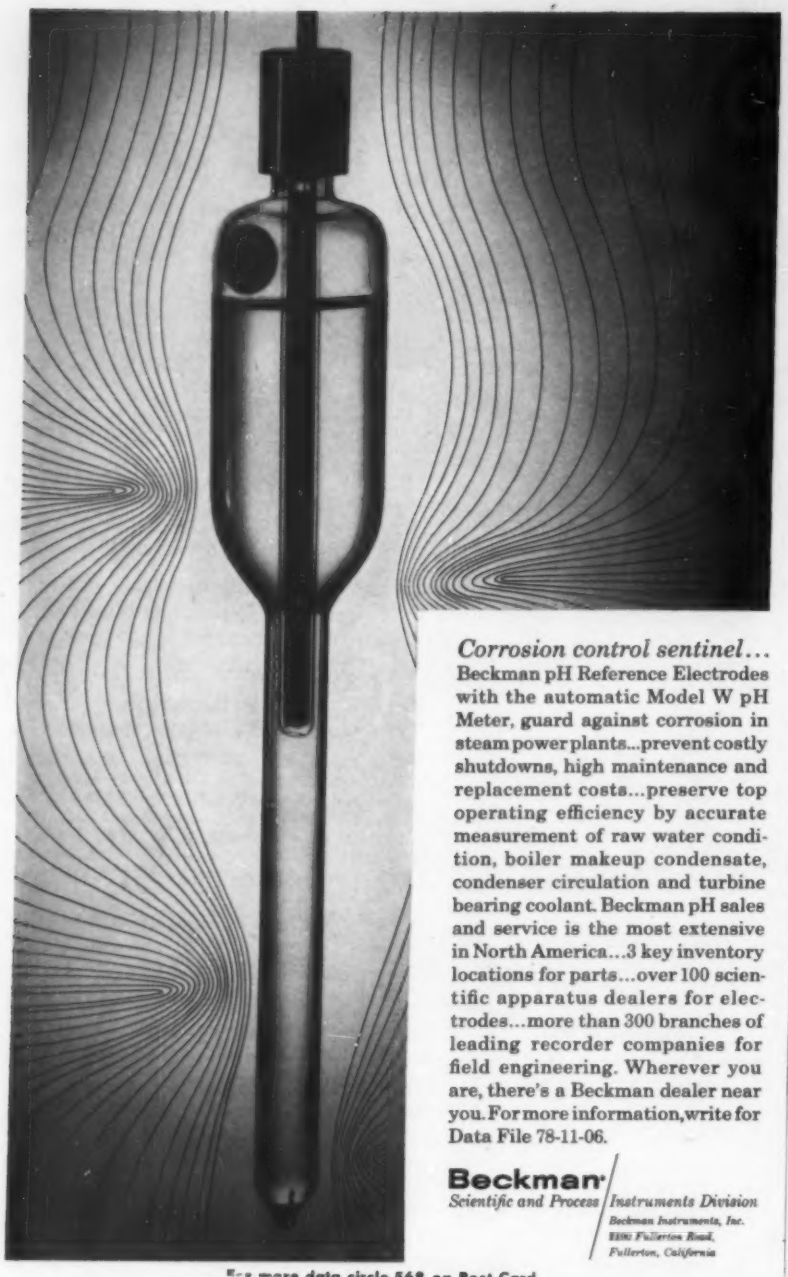

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principles are illustrated and typical installations shown. The Air Preheater Corp.

BOILERS, GENERATORS

244 Fire Tube Boilers — This 12-pp catalog describes Superior Compact packaged boilers in capacities from 20 to 200 bhp. Interesting arrangement of test, illustration and color is used to explain many features. Gives dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

245 Hot Water Boilers — This 20-pp Brochure HCC-2 describes and illustrates design, construction, advantages and economics of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process uses. Combustion Engineering, Inc.

246 Boilers for Many Services — This general product data catalog contains detailed literature on the company's line of boilers for heating, power and process steam. It contains separate data sheets for each product, including high pressure and low pressure boilers, boiler-burner units and water heating equipment. In addition to photos and diagrams illustrating design and operation features, it provides tabular engineering data. Industrial Div., American-Standard.

247 Steam Generator — Sixteen-pp Bulletin M-3A describes features and applications of company's water tube Type CPM steam generator. Complete selection details are given, as well as diagram and principal dimension table. E. Keeler Co.

248 Packaged Steam Generator — Advantages of company's baffleless, pressurized two-drum water tube packaged units are detailed in 12-pp Catalog SB-59. Features of the completely integrated generating plant, which requires no field piping, wiring, brickwork or special foundation, are shown on cutaway illustration. Erie City Iron Works.

249 Integral-Furnace Unit — Bulletin G-94 describes the Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr at pressures to 1150 psi and temperatures to 900 F. Includes information on membrane wall. The Babcock & Wilcox Co.

250 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are finished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

REFRACTORIES

251 Refractory Castable — Bulletin R-40 describes the use of Kaocrete, company's refractory castable, in boiler ashpits. A discussion of the various methods of ash removal, along with the maintenance problems peculiar to each, is presented. Four installations detailed. Refractories Div., The Babcock & Wilcox Co.

252 Refractory Mortar — This is a 24-pp manual covering the use of Lumnite

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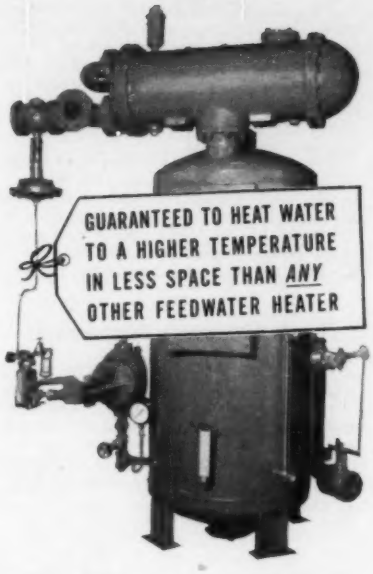

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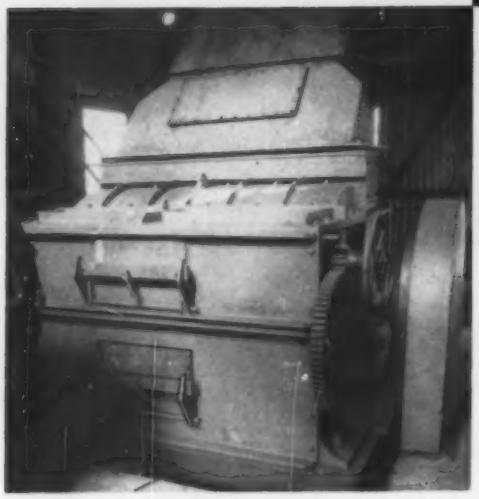

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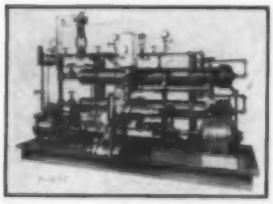

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calcium-aluminate cement as a mortar mix for gun-applied linings in power plant, refinery and metalworking equipment. Includes data on mortar preparation, placing procedures, curing; also information on use of Lumnite cement as a masonry mortar for laying brick. Universal Atlas Cement Div., United States Steel Corp.

COAL AND ASH HANDLING

253 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features. American Pulverizer Co.

254 Coal Crusher — Factors to consider in selecting a coal crusher for a particular operation are detailed in 12-pp Bulletin 154. Types of coal crushers and advantages of each are described and capacity and specification data included. Gruendler Crusher & Pulverizer Co.

255 Hydraulic Shakeout — Bulletin 658 describes and illustrates the Carquake, hydraulically powered car shakeout designed for maximum car shaking with minimum noise. Rail- and stationary-mounted types are shown. Six advantages detailed. Stephens-Adamson Mfg. Co.

FUEL BURNING EQUIPMENT

256 Water-Cooled Stoker — Design and operating advantages of the Vibragrate Stoker are outlined in this illustrated bulletin. A large cutaway view details component parts of the stoker and explains operating features. Other drawings show installations. American Engineering Co.

257 Pumping, Heating Units — Featured in 16-pp Bulletin 40 is a line of fuel oil pumping and heating units for preparing heavy fuel oil for combustion in all types of oil burners. Various types of industrial applications are illustrated, and ratings, specifications, a diagrammatic view of fuel oil pumping and heating unit, given. National Airoil Burner Co., Inc.

258 Spreader Stoker — Catalog 860 contains 20 pp of detailed information on company's overthrow rotor type spreader stoker for boilers of medium size up to 60,000 lb steam per hr capacity. Describes features of design and operation and illustrates applications. Detroit Stoker Co.

TUBING AND ACCESSORIES

260 Tubes and Plates — Publication B-2, 46 pp, covers the subject of tubes and plates for condensers and heat exchangers. Field of application and particular problems encountered in each are described. Information on condenser tube alloys, plates for tube sheets and baffles, manufacturing methods, installation, operational factors affecting tube life, corrosion factors in condenser tube service is presented. The American Brass Co.

261 Aluminum Tube — This 32 pp catalog contains detailed information on company's drawn aluminum tube and extruded aluminum tube and shapes. Describes special features of the metal, metallurgical aspects, mechanical, physical and chemical characteristics, tolerance standards and extrusion definitions. Wolverine Tube, Div. Calumet & Hecla, Inc.

262 Tube Cleaner — Featured in Sheet A-24 is a condenser and heat exchanger tube cleaner weighing only 10 lb. Operation advantages are detailed and specifications listed. Airetool Mfg. Co.

263 Tube Cleaner — Details on the Jiffy Gun for cleaning condenser and heat exchanger tubes are presented in this product bulletin. Such features as spiral-wound nylon brushes with rubber bumpers are illustrated. Elliott Co.

264 Shot Cleaning System — Bulletin 2145 describes advantages and principle of operation of a shot cleaning system for cleaning such external tube surfaces as superheaters, reheaters, economizers, and tubular air heaters. Typical shot cleaning system is diagrammed. Diamond Power Specialty Corp.

TURBINES

265 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multi-stage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

266 Turbine Lubrication — Basic lubrication requirements for a wide range of turbines and gears are detailed in 28-pp Bulletin T-125-A. Sections cover care of the oiling system, turbine lubricants, lubricating oil recommendations, reduction gears and geared units. Oil circuit diagrams and other illustrations are included. Murray Iron Works Co.

267 Gas Turbine Engines — A variety of applications for company's gas turbine engines are described in this 8-pp bulletin. Among the applications described are ground support for commercial jets, emergency shipboard use, offshore oil industry, others. Solar Aircraft Co.

PUMPS, COMPRESSORS

268 Proportioning Pumps — Catalog 604, 8 pp, covers details and specifications of two mechanical and hydraulic drive metering and proportioning pumps, for precision pumping as low as 11 cc per min, and a chemical pump for systems requiring limited capacities. Advantages are given. Hills-McCanna Co.

269 Controlled Volume Pumps — Bulletin 1257 describes company's mini-Pumps for metering chemicals in minute volumes against pressures. Contains specifications on laboratory, industrial and chromatographic designs. Milton Roy Co.

270 Vertical Turbine Pump — Featured in 16-pp Bulletin 2400-B1 is a line of ultra high flow vertical turbine pumps. Design improvements, which result in broader coverage and higher efficiencies over wider operating ranges, are illustrated and described. Worthington Corp.

271 For Abusive Pumping Jobs — Catalog 5206 covers centrifugal pumps for wide industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump: a horizontal shaft, single-stage, rear-entrance automatic priming pump;

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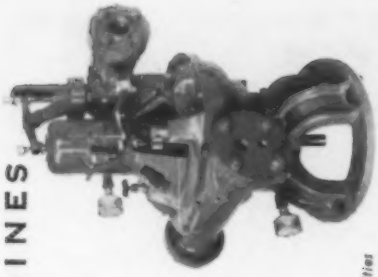

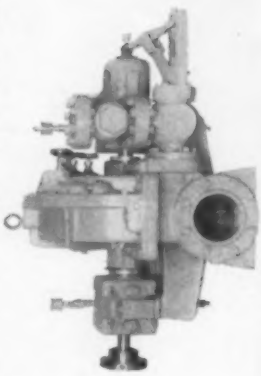

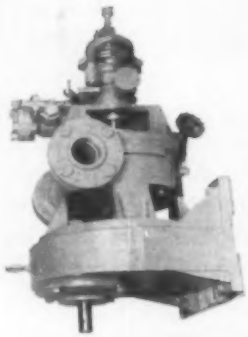

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vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

272 Gear Pumps — Bulletin G-1 describes gear pumps designed for a variety of difficult pumping applications. Cutaway view illustrates construction and operation details and tables give dimensional data. Schutte and Koerting Co.

273 Air Compressors — Performance advantages of company's heavy duty V-vertical air compressor featuring aluminum maintenance and compactness are detailed in 24-pp Bulletin A-62. The V-vertical construction details are shown on cutaway and components described, as well as force feed lubrication and mounting types. Specifications given. Joy Mfg. Co.

INSULATION

274 Pipe Insulation — This 40-pp catalog was designed as a reference guide to company's pipe insulation, presenting a new way to specify proper thickness for pipe insulation, based in the "J" factor. This special index eliminates complicated computation formerly required to determine economical thicknesses. The book also features detailed drawings that show how single-layer insulation is applied to various vertical and horizontal expansion joints as well as to pipe bends, flanges, fittings. Union Asbestos & Rubber Co.

275 Thermal Insulation — Insulation solutions for a variety of temperature problems are detailed in this bulletin. Describes insulations for high temperatures, intermediate temperatures, hot and cold water-low pressure steam, ice water and frigid temperatures, and miscellaneous applications. An insert discusses advantages of company's expanded polystyrene board and pipe covering. Mundet Cork Corp.

276 Foam Insulation — Expanded polystyrene insulation for cold storage applications is featured in this illustrated bulletin. Method of application is shown and physical and thermal properties of the material listed. Johns-Manville.

OTHER EQUIPMENT

277 Fuel Oil Additive — Described in this product sheet is an additive for boilers suffering from "tired" fuel oil. Advantages and characteristics are detailed. Kor Corp.

278 Story of Coal — This pocket-size booklet presents a complete picture of company's operations, traces the history of the coal industry and describes the many services and applications of coal. A colorful mural reproduced in the booklet pictures the part coal has played in civilization. Peabody Coal Co.

279 Organized Lubrication — Benefits of organized lubrication — major cost control factor — are extolled in this 24-pp bulletin. Cost control opportunities are detailed and the task of assigning responsibilities and delegating authority in an organized lubrication system discussed. Method of determining savings and setting up records to measure results is also covered. Texaco.

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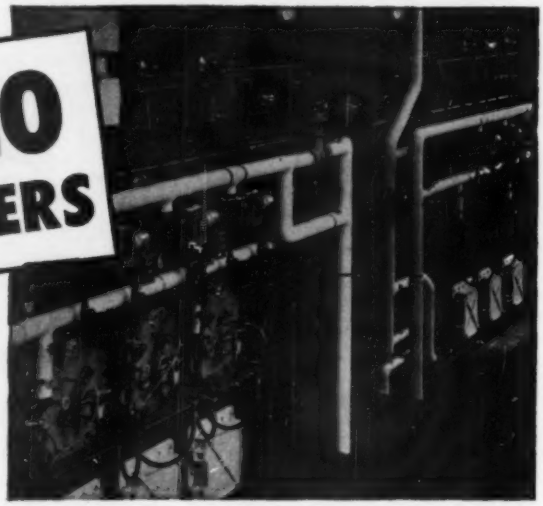

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280 Brine-Making Manual — Details on modern brine-making methods and equipment are presented in 12-pp Manual 135. Three types of brine-makers are described, as well as a wet salt storage system, and cutaway views and diagrams are included. Morton Salt Co.

281 For Quiet Heating — Described in this bulletin is the HusHeater, designed to heat — without making a sound — water and liquids by introduction of steam into the liquid. Lists advantages of the HusHeater. Most common application is in filter boxes and hotwells. Sims Pump Valve Co. Inc.

282 Aluminum Jacketing — Bulletin 530a describes company's line of aluminum weather-proof jacketing for insulated lines, towers, vessels and tanks. Application procedures are pictured and suggested specifications offered. Childers Mfg. Co.

283 Mechanical Packings — Catalog P-210C contains 40 pp of detailed information on company's line of mechanical packings and gasket materials. It contains illustrations, descriptions, complete service recommendations and specification charts. Raybestos-Manhattan, Inc.

284 Process Equipment — Bulletin G-3B describes equipment for process industries, including pneumatic conveying systems, compressors and vacuum pumps, coolers and preheaters, blowers, gas and vacuum pumps, fans and gas washers, accessories. In addition to describing features and advantages of the equipment, it includes engineering data. Fuller Co.

285 Equipment Selector Charts — Bulletin CE-50, 20 pp, contains selector charts on corrosion-resistant equipment for process industries. Tables cover general considerations in selection of material, physical properties, corrosion resistance. Describes rubber and plastic pipe, tubing and fitting; valves; pumps; lined tanks. Amerace Corp, American Hard Rubber Co.

286 Laboratory Supplies — This 12-pp price list announces latest prices for a wide range of laboratory supply items, including water analysis sets, conductivity equipment, colorimetric comparators, glassware and supplies, chemical reagents, and company's photometer with replacement accessories. Betz Laboratories, Inc.

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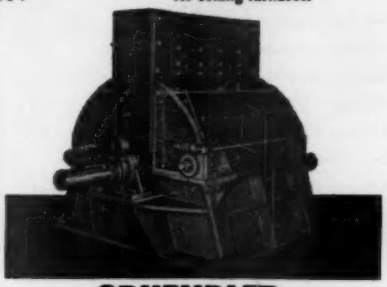

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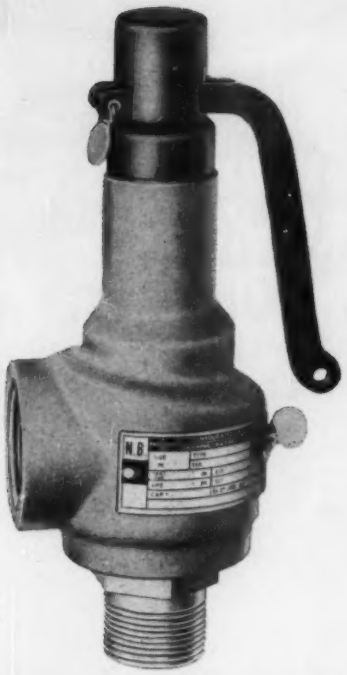

NEW
high capacity
BRONZE PORTABLE VALVES
reduce initial valve cost

Consolidated Safety Valve Type 1540 Series. Sizes: ½" thru 2½". Pressures to 250 psi. Temperatures to 406°F. Available with side or top outlet.

These new Consolidated Safety Valves are specifically designed for such applications as package-type steam generators, fire tube boilers, and air compressors. High-capacity design reduces the size and/or number of safety valves required.

You can be sure of stable performance and uniform blowdown control. These bronze portable valves have a precision-wound, calibrated spring aligned with cone-shaped spring washer bearings. The integral combination adjusting ring and disc guide are double guided. Alignment is better, blowdown adjustment is easier, operations finer. Positive tightness is certain: the seat is machine lapped to optical flatness. Opening is sharp and clean, without simmer. Lifting lever is fully adjustable over more than 300°.

When a lower capacity rating is adequate, you can choose valves in medium capacity to conform closely to actual capacity requirements. Capacities, sizes and descriptions of new Consolidated Bronze Portable Safety Valves are given in Bulletin 740. Write for a copy.

Industrial distributors in all principal cities backed by convenient regional warehouses are ready to serve you.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

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PUT

IDEAL Performance

into your

PUMPING

for greater

EFFICIENCY and ECONOMY

VERTICAL
Hollow or Solid Shaft
MOTORS

From top to bottom, IDEAL Vertical Motors are engineered for maximum ease and economy of installation, operation and maintenance. A few of the outstanding features include:

- cast-aluminum drip covers
- non-spilling drain plugs
- flush mounted oil sight gages
- standard or special mounting bases
- thrust bearings sized to each application.

IDEAL Vertical Motors are available in a wide range of HP ratings with enclosures and insulations to meet all environmental conditions. Consult IDEAL for Vertical Motors built to your most exacting specifications.

Ask for Bulletin 212 (15-125 HP) and Bulletin 219 (150 HP and larger)

The IDEAL ELECTRIC & MANUFACTURING CO.

319 East First St. Mansfield, Ohio

SINCE 1903, AMERICA'S FINEST MOTORS, GENERATORS, MOTOR-GENERATOR SETS, SWITCHGEAR AND CONTROLS.

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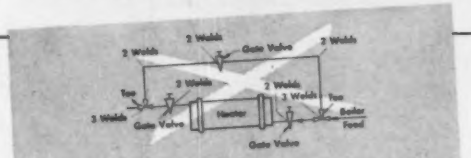
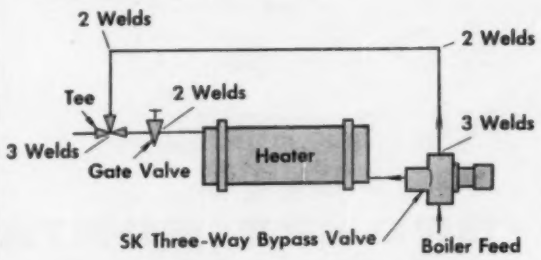
NEW VALVE SAVES COST ON FEEDWATER HEATER BYPASS ARRANGEMENTS



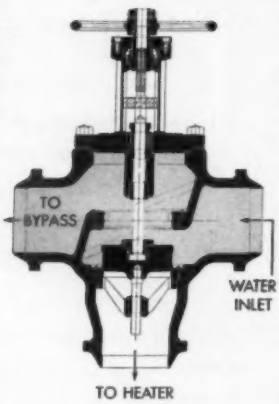
OLD BYPASS ARRANGEMENT

Used three conventional two-way valves . . . required two tee fittings and sixteen high pressure welded connections—usually of radiographic quality.



NEW BYPASS ARRANGEMENT

Makes previous arrangement obsolete . . . uses only one SK Three-Way Bypass Valve . . . requires only one tee fitting, only twelve welded connections.



The new feedwater heater bypass arrangement shown saves one two-way valve, one tee fitting, four welded connections and *cuts costs accordingly*.

Heart of the new system is the SK Three-Way Bypass Valve illustrated. This valve is designed for two-position operation. With the disc closed against the lower seat, flow passes through the bypass line. With the disc closed against the upper seat, flow is to the heater. The valve can be equipped with gearing or motor operator. Bulletin 8F contains full details—is available on request.

SK also manufactures Check Valves for extraction or bleeder lines and other special applications. For details, request Bulletin 8K.

Schutte and Koerting COMPANY

Manufacturing Engineers Since 1876

2221 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

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JET APPARATUS • ROTAMETERS • GEAR PUMPS • VALVES • HEAT EXCHANGERS

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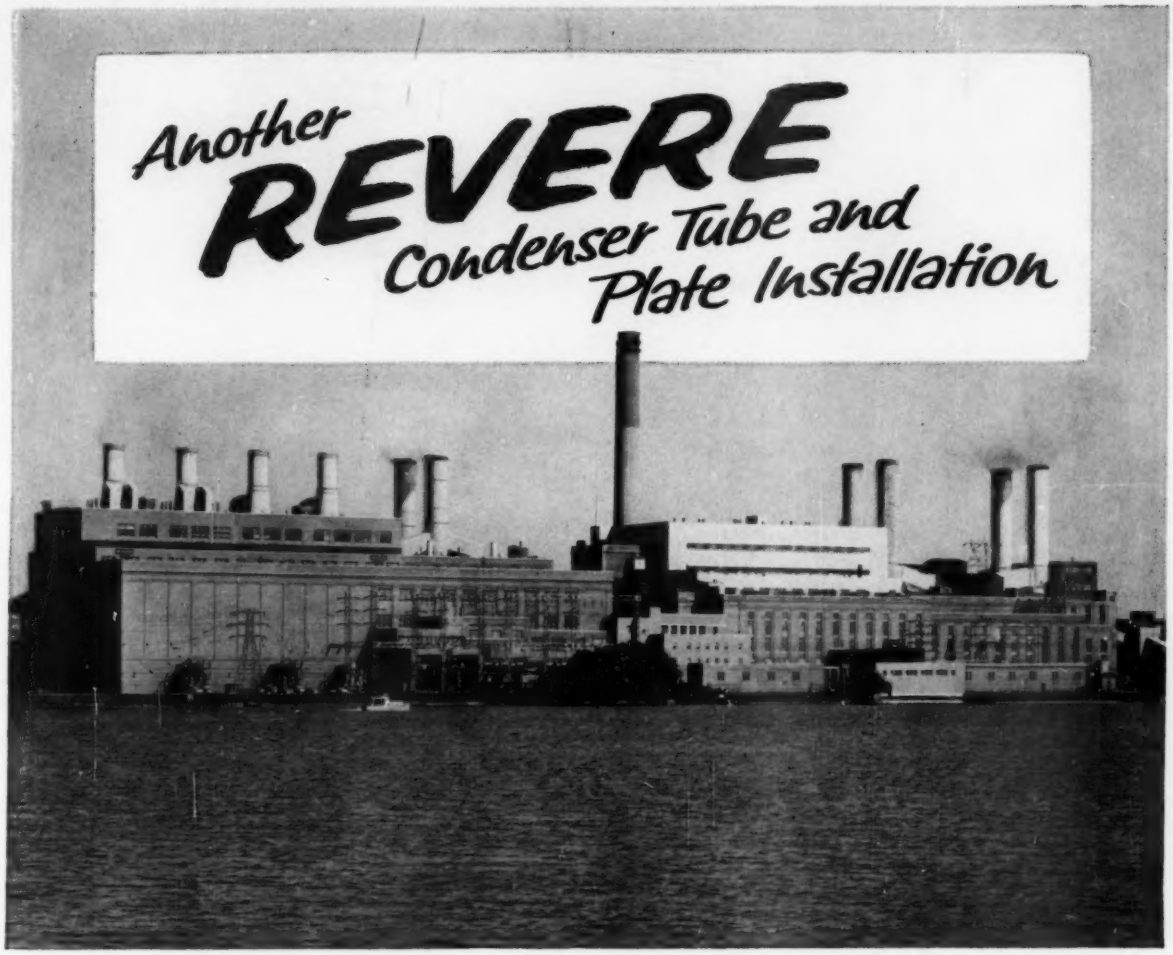

Another Dependable Worthington Condenser for

NIAGARA MOHAWK POWER CORPORATION

(Unit #67 Huntley Steam Station, Buffalo, N. Y.)

The 95,000 sq. ft. Worthington Surface Condenser is equipped with 196,000 pounds of Revere Admiralty Condenser Tubes, and 29,000 pounds of 1½" thick Revere Muntz Metal tube sheets.

These particular metals were selected by the manufacturer because they best fit the specific operating conditions that will be encountered in this particular installation. Other operating conditions and requirements call for other alloys.

It is this careful selection of the "metal to fit the job" that has built, for Revere, a reputation for dependable condenser tube and plate performance under all kinds of operating conditions.

Over the years Revere's Research Department has compiled extensive data regarding the relative corrosion resistance of the different alloys under a wide variety of operating conditions. Why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before selecting the tubes and plates for your equipment?

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

INTEGRAL FINNED TUBE • BIMETAL TUBE • INSTRUMENTATION TUBE • CONDENSER TUBES IN CUPRO-NICKEL, ALUMINUM BRASS, ADMIRALTY, HERCULOY, ARSENICAL COPPER, MUNTZ METAL AND OTHER ALLOYS. ALUMINUM TUBE, SHEET AND EXTRUSIONS. SMALL AND LARGE PLATES IN CUPRO-NICKEL, COPPER, HERCULOY, MUNTZ METAL, NAVAL BRASS AND ADMIRALTY.

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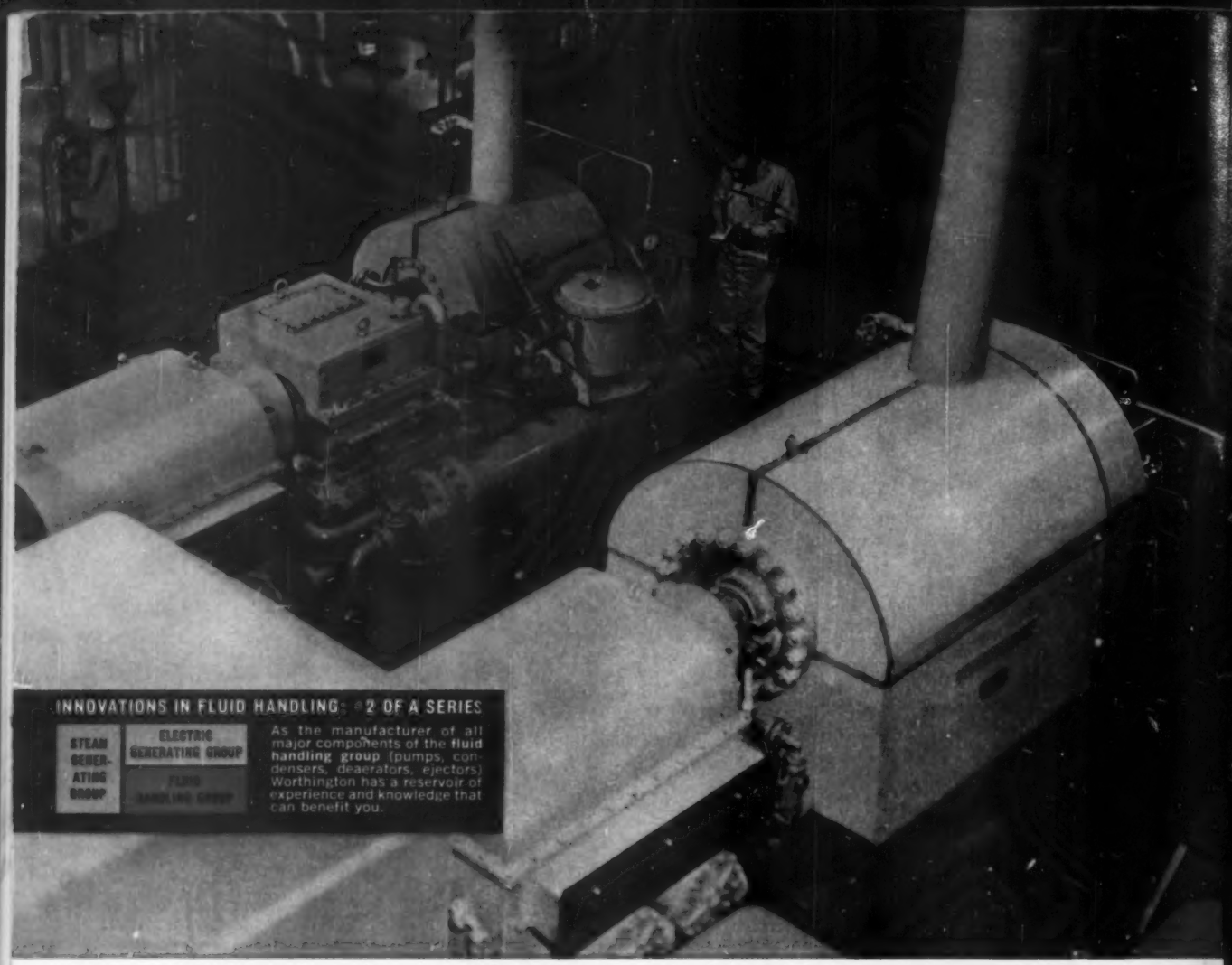
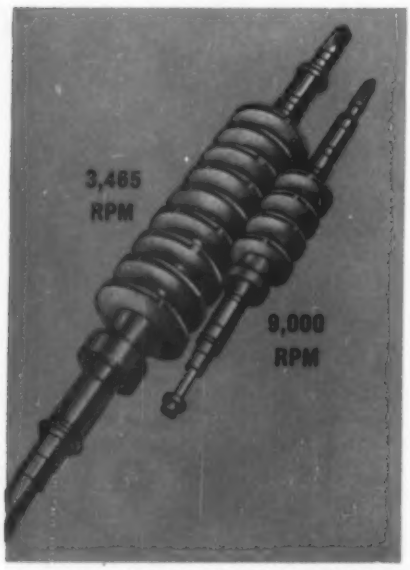

INNOVATIONS IN FLUID HANDLING: #2 OF A SERIES
STEAM GENERATING GROUP
ELECTRIC GENERATING GROUP
FLUID HANDLING GROUP
As the manufacturer of all major components of the fluid handling group (pumps, condensers, deaerators, ejectors) Worthington has a reservoir of experience and knowledge that can benefit you.

This photo measures pump progress. Here are two boiler feed pumps with duplicate pressure and capacity ratings. On the right is a unit of conventional speed; the other is the fastest pump of its type in service, running at 9,000 rpm. Smaller size is dramatically evident.



Comparison of rotors. The rotors used in the two pumps above are shown here. The 4-stage rotor used in the high speed pump will have one-third the deflection of the 9-stage rotor in the conventional unit.

PUMP PARADOX

High speed boiler feed pumps are several times as fast, yet actually more reliable

In modern power plants, the demand for higher efficiency has led to higher operating pressures and, therefore, higher heads for boiler feed pumps. This is a critical area for the fluid handling group. Can you obtain these higher heads without sacrificing reliability?

Worthington has proved that you can. By going to speeds twice as fast (and even greater) Worthington drastically reduces shaft spans required. This cuts shaft deflection to a fraction of its former value. Since pump wear, and hence pump life, is directly related to shaft deflection, the high speed pump is actually more reliable than a conventional unit of the same capacity.

Experience in the field has proved the wisdom of Worthington's design philosophy. More than 39 Worthington high speed pumps are now installed and 21 are on order. Speeds range from 6,500 to 9,000 rpm. If necessary, Worthington sees no reason why speeds shouldn't go even higher, without departing from experience-proved construction principles.

Reducing shaft deflection through shorter shaft span is only one way that Worthington increases boiler feed pump reliability. Other ways include larger shaft diameters, liberal clearances, shrunk on impellers, metal-to-metal pressure joints, a special method for measuring internal wear, and anti-oil-whip bearings.

High speed boiler feed pumps are one example of Worthington's leadership in the fluid handling area. Through the years Worthington has made many contributions to the solution of power plant problems. Why not put this progressive "know how" to work on your next plant? Worthington Corp., Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

45-6

WORTHINGTON